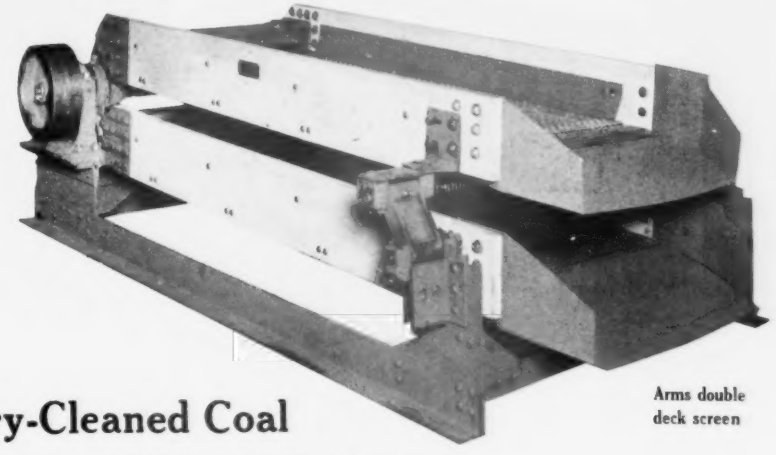
The MINING CONGRESS JOURNAL

Volume 12 SEPTEMBER, 1926 *Number* 9



Arms double deck screen

Dry-Cleaned Coal for the 1926-1927 Market

R and S Dry-Cleaning Equipment

is noteworthy for its high efficiency, high capacity, economy of power and economy of space occupied. This equipment is designed and installed only after the coal in question has been thoroughly tested in our testing plant at Harvey, Ill., where tests are made on carload samples of coal.

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In this highly competitive market continually demanding better preparation, Dry-cleaning by Arms Screens and Air Concentrators is already an effective sales argument. The process is described in our Bulletins Nos. 75 and 77.

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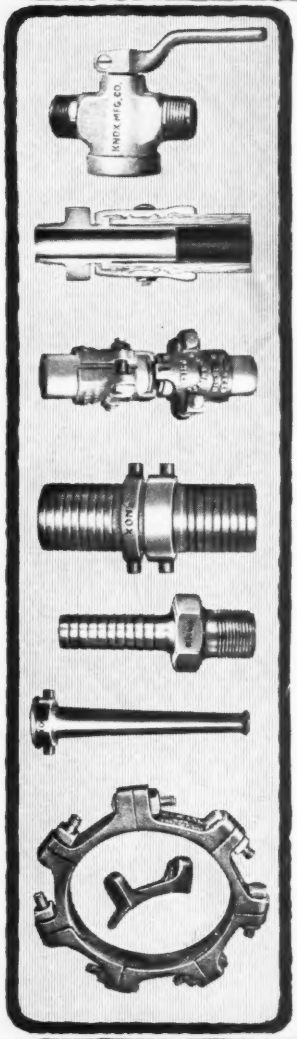

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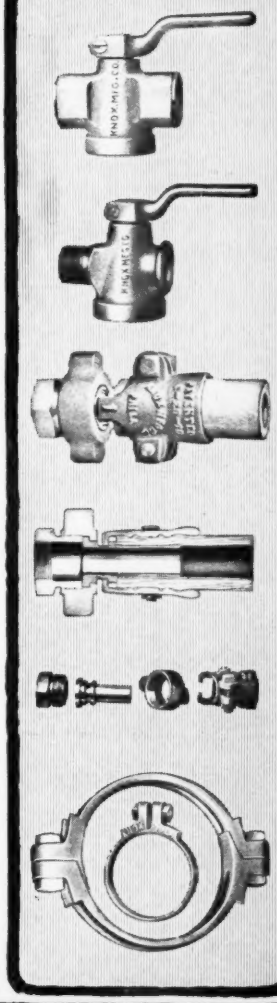

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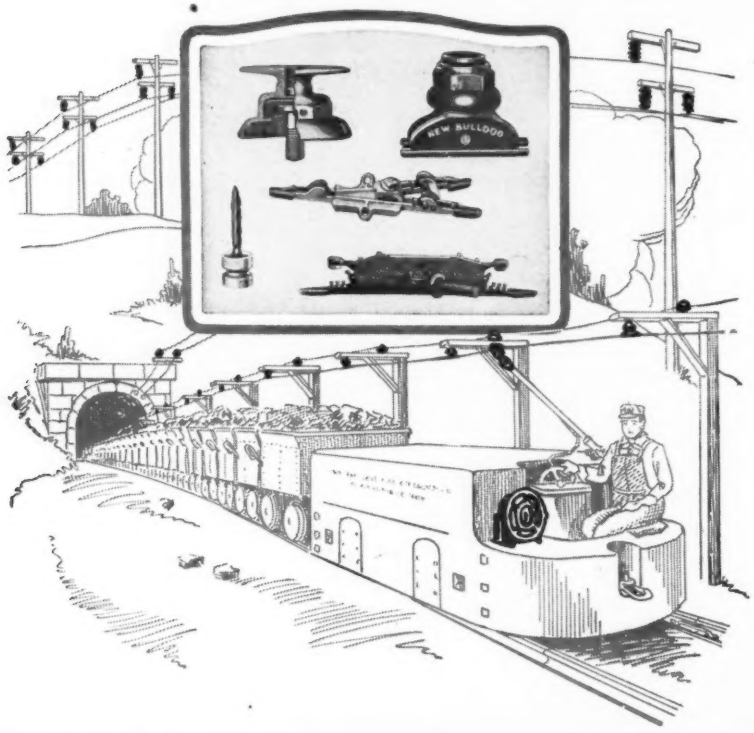

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THE MINING CONGRESS JOURNAL

SEPTEMBER, 1926

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PRACTICAL OPERATING MEN'S DEPARTMENT

METALS

Sampling and Estimating the West Ore Body of Sacramento Hill

Water Treatment and Underground Leaching at Bisbee Mines of Calumet and Arizona Mining Company

COAL

Efficient Organization in the Coal Industry

Modern Types of Gas Masks and Respirators for Mines

Published Every Month by the American Mining Congress, Washington, D. C.

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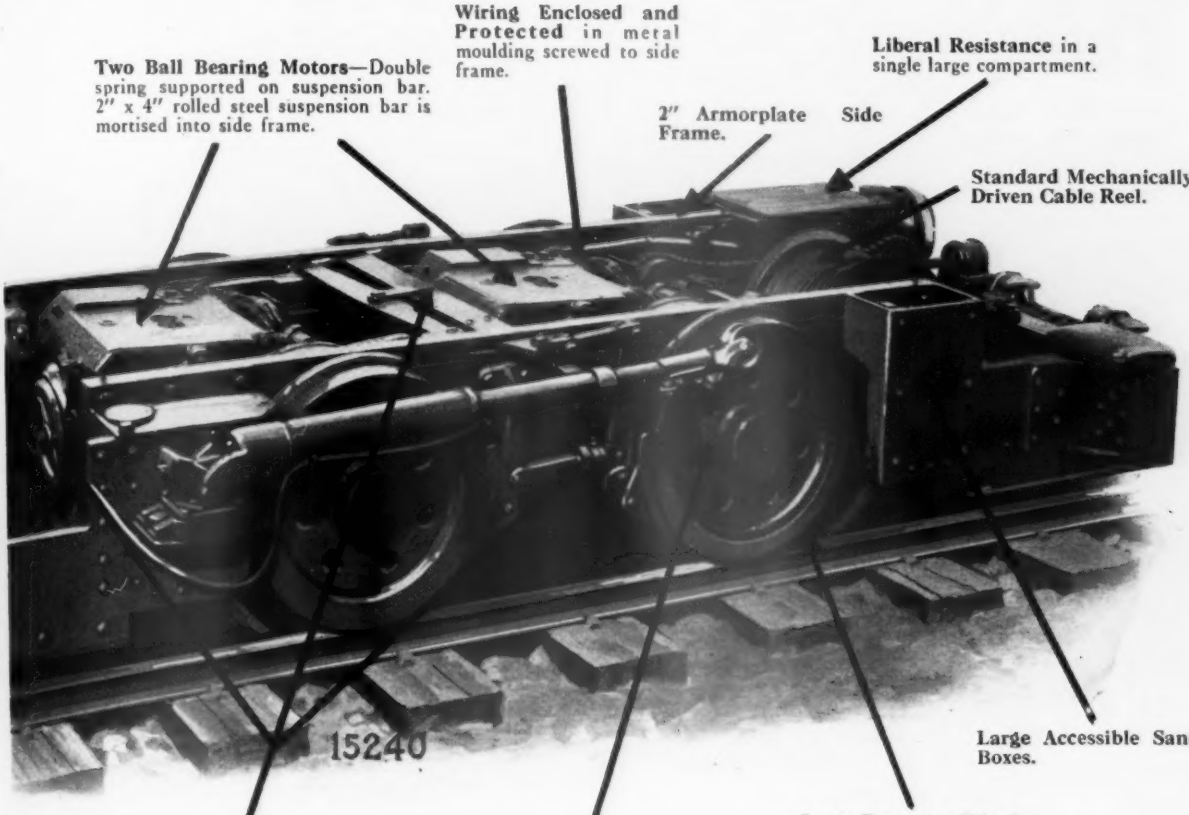

Two Ball Bearing Motors—Double spring supported on suspension bar. 2″ x 4″ rolled steel suspension bar is mortised into side frame.

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Liberal Resistance in a single large compartment.

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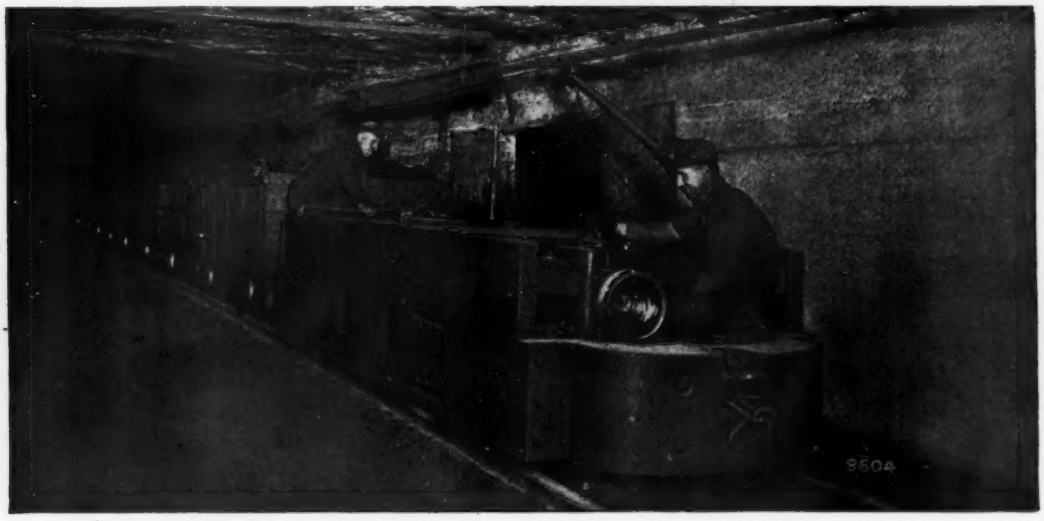
ARMORPLATE Type Haulage Locomotive

(Trade Mark Reg. U. S. Pat. Off.)

Built in 8, 10, 13, 15, 20, 25 and 30 Ton Sizes



Some Special Features:

ARMORPLATE Type Frame of rolled steel slabs—practically indestructible—also allows the greatest amount of room for motor equipment for the gauge of track and the allowable overall width.

IMPROVED JOURNAL BOX. Enables locomotive to follow swails in track easily and exert full tractive effort. Long flexible springs—locomotive follows uneven track; Hardened Tool Steel Pin in end of axle takes end thrust of the wheel and axle.

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Special Heavy Duty Controllers.

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Combination Cutter and Loader
Drills
Conveyor-Loader
Sectional Conveyor
Pit Car Loaders
Locomotives
Mine Fans
Tipple Equipment
Crushers

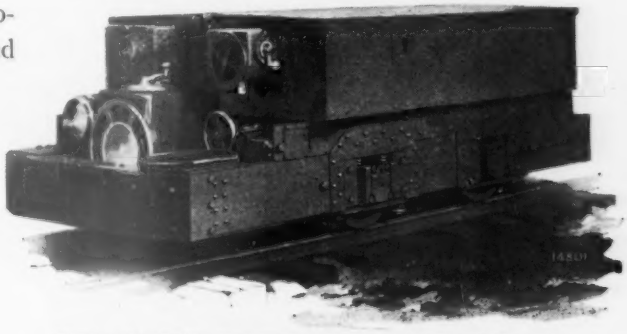
A COMPLETE LINE FOR CUTTING, LOADING, HANDLING & VENTILATING

Storage Battery Gathering Locomotive

JEFFREY Storage Battery Locomotives are constructed along the same general lines of Jeffrey Trolley Locomotives. In fact, many standard trolley locomotive parts are used in the construction of the battery locomotive chassis. The motors are designed especially for voltages on which they work, are liberal in design, and have a high efficiency.

The Gathering Battery Locomotives are built in 6,000-lb., 8,000-lb. and 10,000-lb. chassis. Large Haulage Battery Locomotives can be furnished in sizes from 20,000-lb. to 26,000-lb. chassis. Edison or Lead Batteries.

Pivoted Battery Box gives an accessible locomotive without removing the battery box; however, it is so arranged that battery boxes can be easily and quickly changed.



Jeffrey Permissible Type Battery Locomotive. Completely constructed of Government Approved units. The battery capacities range from as low as 10 kw. hours up to 120 kw. hours. They can be equipped with either Edison or Lead Batteries.

Battery gathering locomotives bearing U. S. Government name plate are the only approved locomotives for use in gaseous mines. Their safety features are self evident.

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COAL MINE EQUIPMENT

Jeffrey-Standard Coal Mine Equipment

Coal Cutters
Combination Cutter and Loader
Drills
Conveyor-Loader
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Pit Car Loaders
Locomotives
Mine Fans
Tipple Equipment
Crushers

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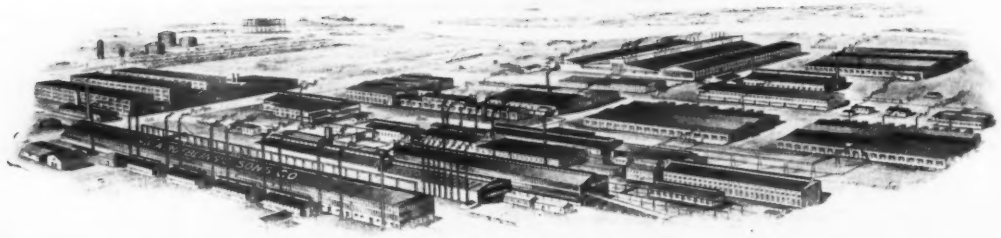

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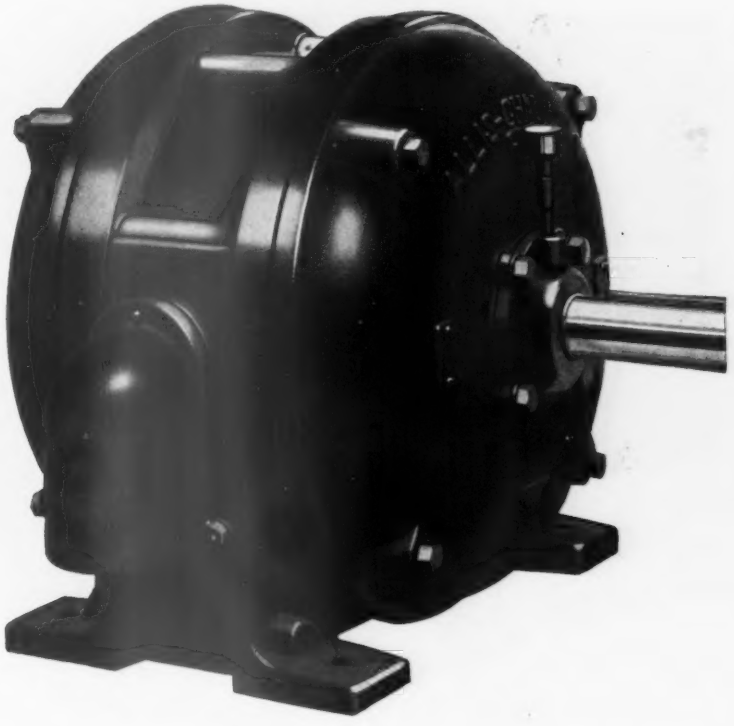

Note the clean lines of Allis-Chalmers Enclosed Motors. "Attached" parts are not needed. The motor housing is really its own seal, containing no openings but the small covered gauge aperture. Smallest overall size is made possible by the use of Timken Tapered Roller Bearings. Their load capacity reduces shaft length.

Completely Enclosed— but not Bulky

Bearing capacity is so much greater that shaft length averages 15% less in Allis-Chalmers motors equipped with Timken Tapered Roller Bearings. Applied to enclosed motors this means that Timkens very largely offset the usual increase in size to obtain radiation.

These bearings, free of excess friction, also lend themselves to such tight enclosure that they never need lubrication more than a few times yearly. The entire motor is just as fully protected in the Allis-Chalmers enclosed type. Solid cast end housings are fitted with machined precision. *Gone are the old, crude, easily damaged covers and gaskets.*

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Such bearings constantly maintain the full gap. The rotor also is insured by A-C silver brazed bars. Distortion is unknown in A-C cores. Insulation is exclusively processed to last for the life of the motor. And electric steel is used wherever possible as the foundation of Allis-Chalmers motors. In every type, at every point they beat down motor costs.

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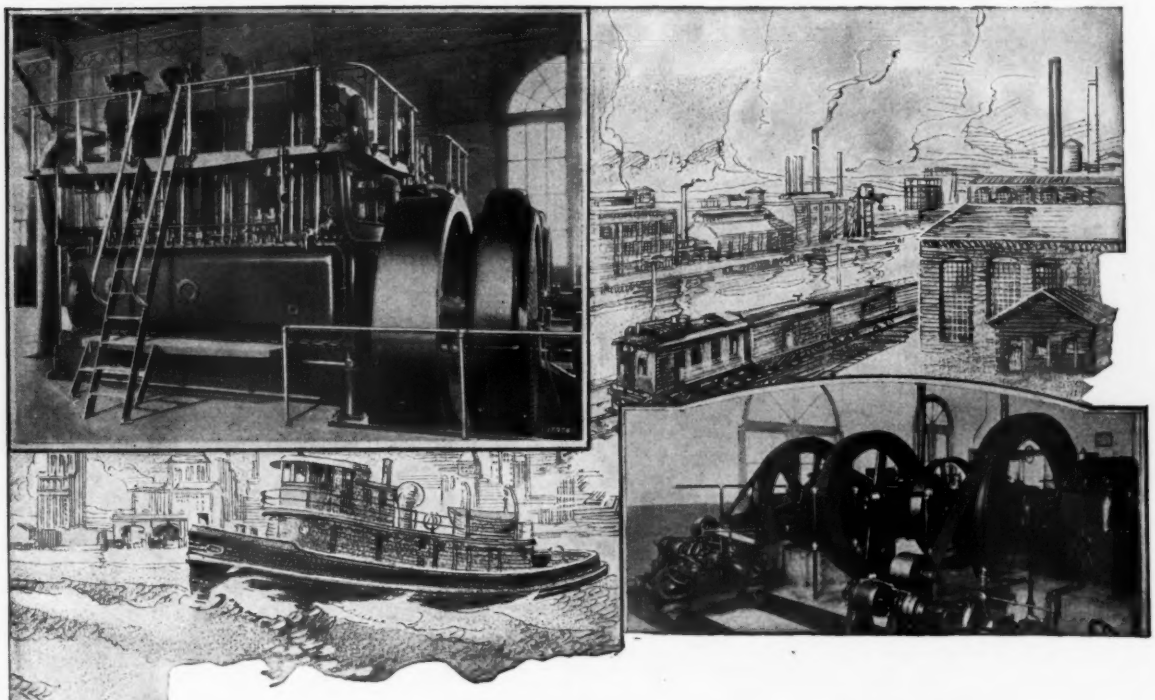

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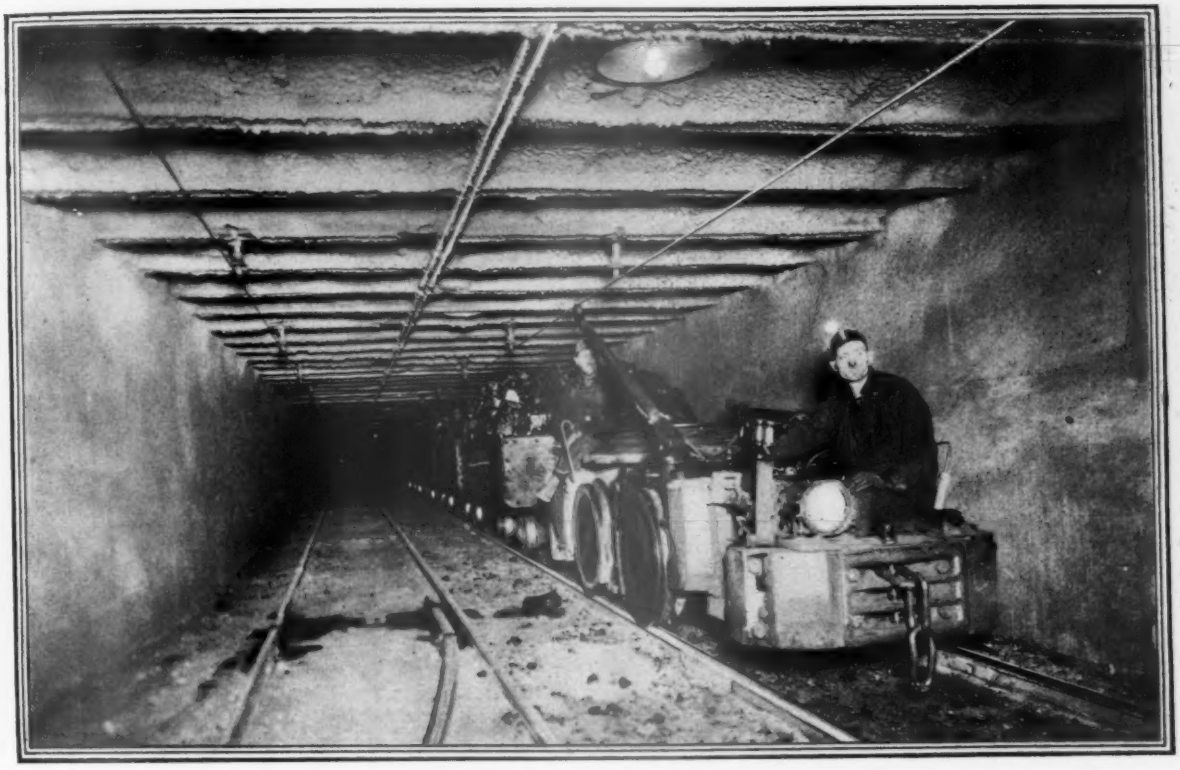

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and Slow Burning
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Lead and Braid Covered
Paper Lead Cable
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Copper and Hitenso

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It is tough, strong and durable. Its conductivity is unexcelled because it is made of Anaconda Electrolytic Copper over 99.9% pure.

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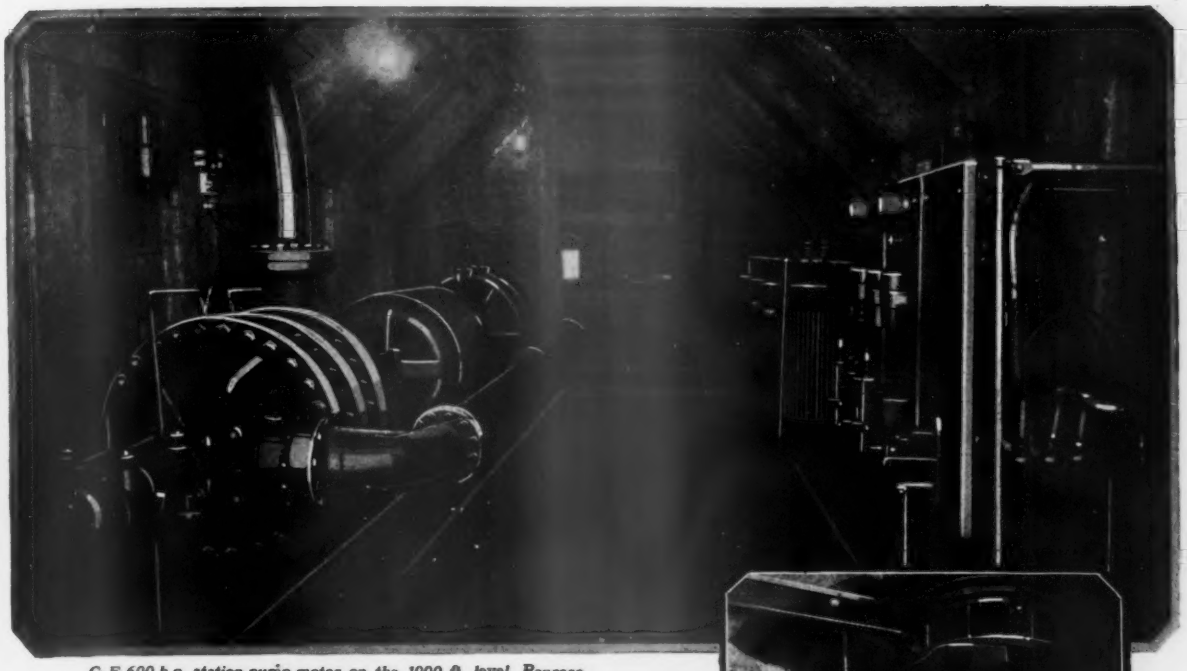


G-E 600 h.p. station pump motor on the 1000 ft. level, Penrose shaft, Down Town Mines Co., Leadville, Colo.

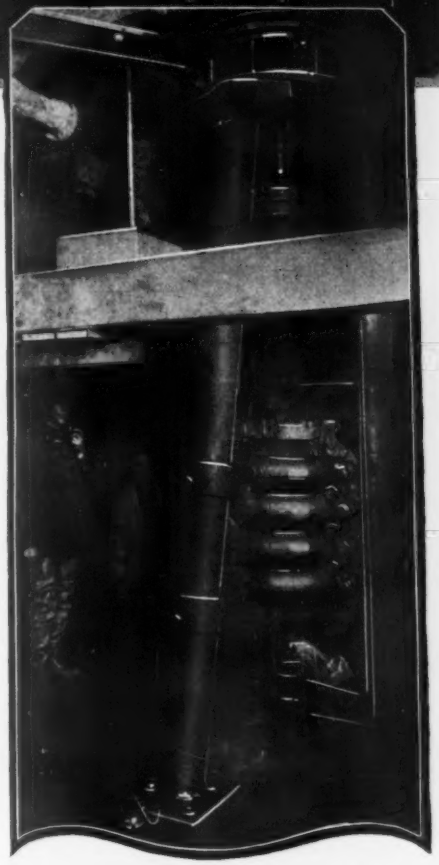
The Challenge to Moisture

G-E mine pump Motors withstand severest wet mine conditions

A feature of particular interest to every mine engineer is the special moisture resisting protective coating on G-E motor coils. This preserves the insulation from all inroads of moisture and does not interfere with the dissipation of heat from the windings.

G-E mine pump motors have high operating efficiency and withstand injurious underground conditions, continuous load, high room temperatures, moisture laden atmosphere, acidulated moisture, submergence and indifferent attention.

Our mining specialists will gladly furnish you with complete information as to the most suitable pump motor drive for your particular work.



For un-watering the Penrose shaft of the Down Town Mines Co., Leadville, Colo., there are four G-E 300 h.p. vertical induction motors used as sinkers.

7A-62

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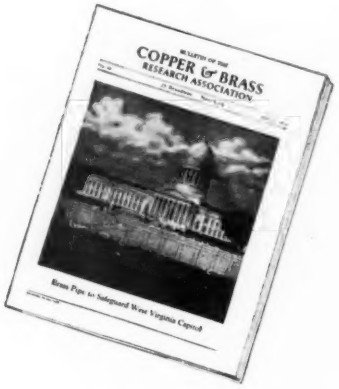

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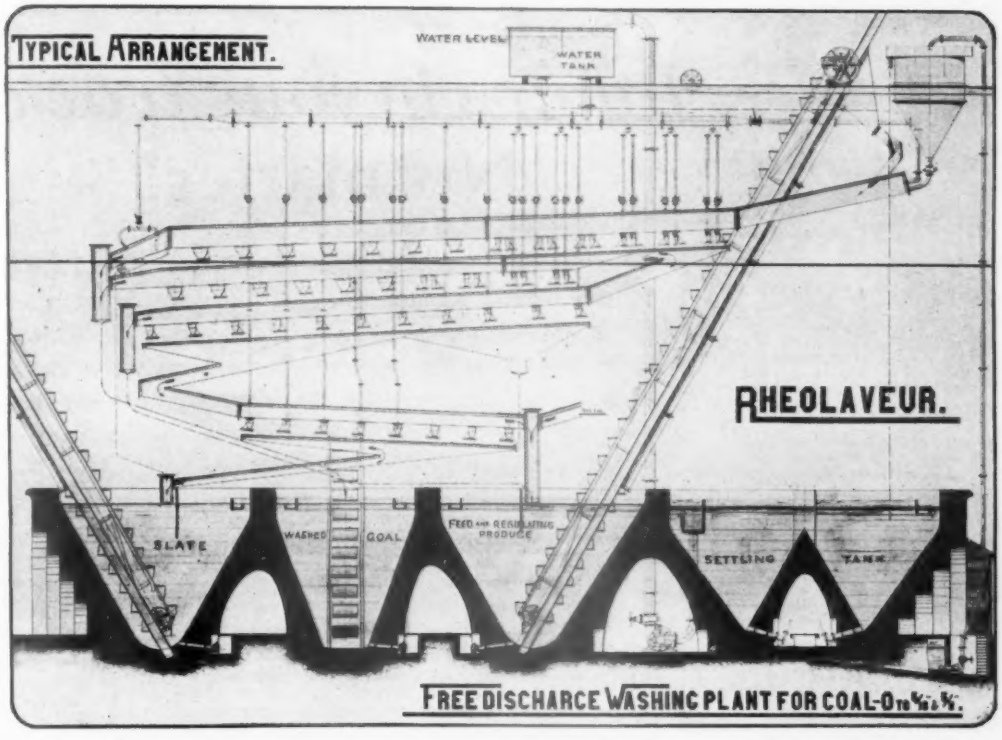

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How and why it's built like the Vulcan Steam Locomotive

Here is the answer to the demand of the industry for a Trolley Locomotive with the same shock-resistant, long-service features as the Vulcan Steam Locomotive.

3-Point Suspension

This 3-Point Suspension of the entire chassis is an exclusive feature of the Vulcan Trolley Locomotive. One pair of springs supports the frame through one set of hangers. One end of another pair of springs is held by other hangers. The opposite ends of the springs engage an equalizing bar extending across the machine and supported in the center. By means of this arrangement shocks are absorbed, the weight is evenly distributed and the locomotive runs smoothly over any ordinary inequalities of track.

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Each side frame is cast in one piece and of steel bar design, thus combining maximum rigidity as well as accessibility. The open spaces permit ample ventilation and simplify inspection.

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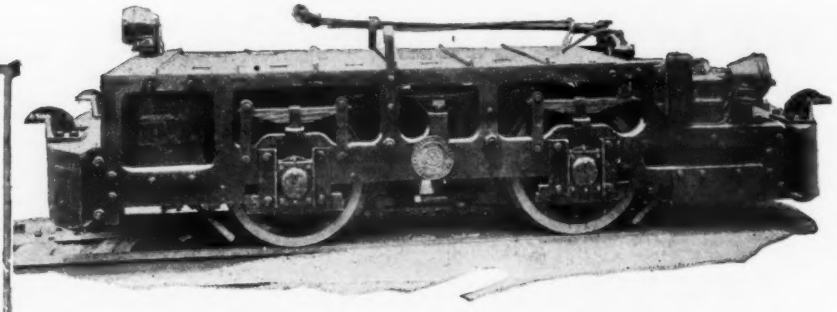

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DECREASE friction on the car wheels, and a mine locomotive will pull a longer string of cars.

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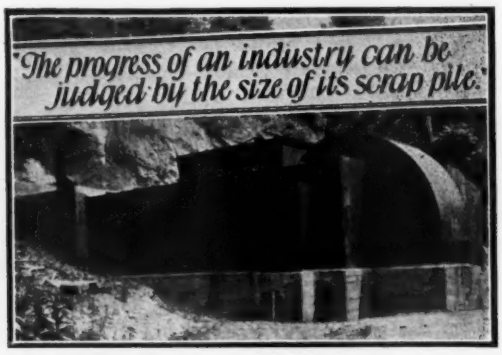

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250,000 ft. at 2 1-2 in. water gauge

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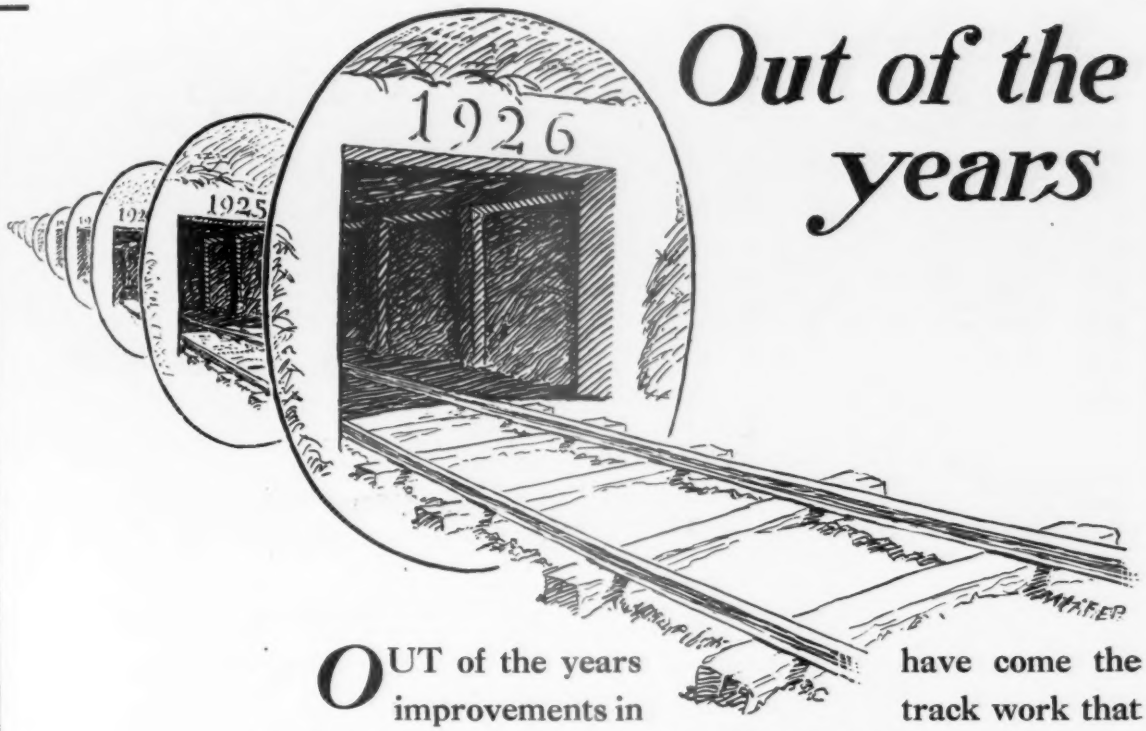
LOOK TO YOUR AIR COSTS IN FIGURING PROFITS



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OUT of the years have come the improvements in track work that have reacted upon many phases of mine haulage. Larger cars with smaller wheels have been made possible; greater speed of trips; costly derailments made unnecessary; car equipment and maintenance and many other transportation costs reduced.

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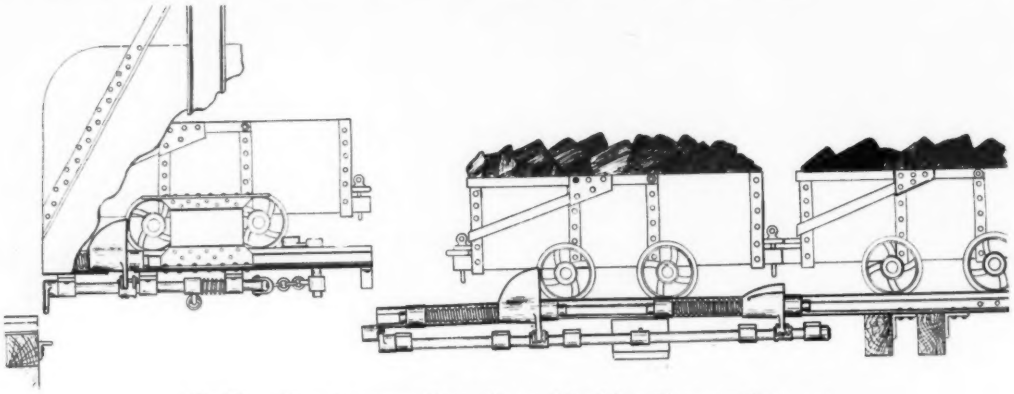

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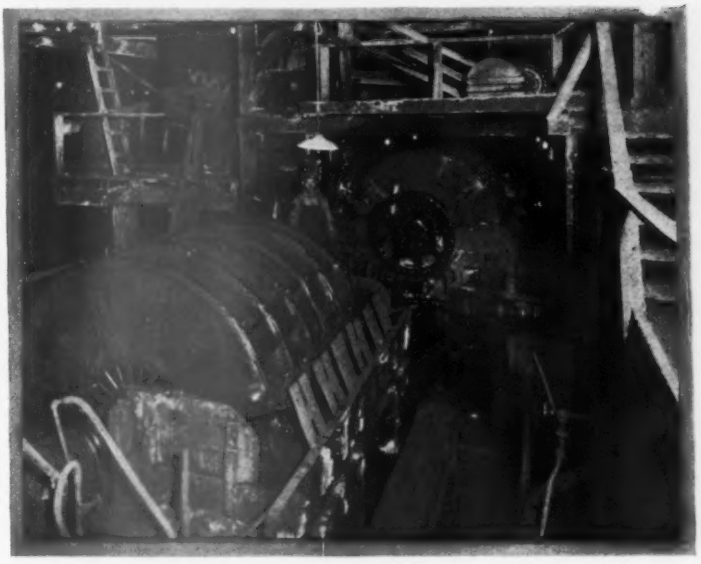

American Continuous Filter made in 18 sizes; dewaters from ⅛ ton to 2 tons of mill products per sq. ft. filter surface per 24 hours. Largest size has 1,000 sq. ft. filter area.

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Will grind from FOUR TO TEN TONS of ORE with the same power that it takes other mills to grind ONE TON of Ore.

No big buildings. NO COST for the CRUSHING LOAD of ROCK in top drum.

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The Most Compact Electric Jigging Conveyor Drive

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They impart that correct and most efficient jigging conveyor motion which is the prime requisite of successful conveyors. They make notable additions to the family of Eickhoff Air and Electric Drives, and make the Eickhoff Conveyor even more desirable than it has been heretofore.

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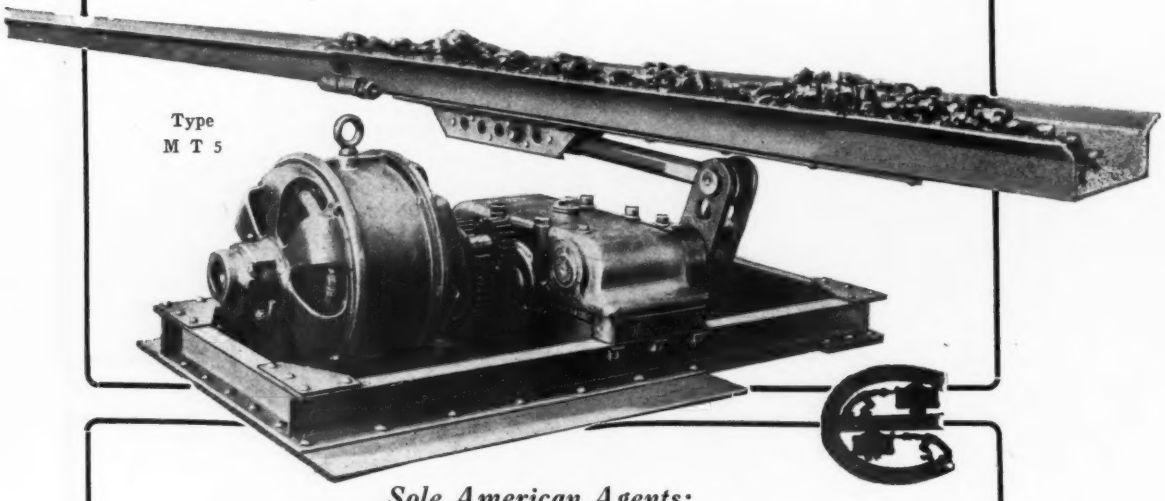

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THE DENVER CONVENTION

THE meeting of the Western Division of the American Mining Congress at Denver, during the week of September 20, will command widespread attention owing to diversity of organized effort that is to be represented there. Western chapters of the American Institute of Mining and Metallurgical Engineers, the American Association of Petroleum Geologists, and the American Silver Producers Association, will meet at the same time to discuss jointly problems that are of common interest. So that while the sessions of the American Mining Congress are busy with legislative and economic policies that pertain to the western metal-mining industries generally, the Institute group will consider practical and technical operating matters, the Petroleum Geologists will deal with problems affecting oil development in the West, and the Silver Producers will take up the question of promotion and stabilization of silver prices and markets.

The assembling of these groups at the same time, and their joint consideration of problems affecting the mining industry in the West, is peculiarly significant in that it indicates the existence of a spirit of cooperation and a unanimity of opinion which are vitally necessary for the adequate protection of their interests, the advancement of their enterprises, and the improvement of economic conditions in their section of the country.

Their deliberations, conclusions and recommendations are certain to exert a tremendous influence upon future developments in the western mining fields, as well as upon national policies which must be evolved and inaugurated upon sound bases if western mining is to keep pace with the progress in other sections of the country and in other lines of business.

The fact that their activities are far removed from the seat of the National Government will not cause them to be ignored or slighted in matters affecting their interests, if their strength is united and their needs are made known through an articulate organization. Congress and the executive departments at Washington will fail to properly interpret conditions and to formulate policies to adequately meet those conditions, only when the western mining industry fails to present a united front on the issues that require action in Washington. Experience has shown that where all the branches of a great industry stand behind a movement looking to the solution of a vital problem that problem receives the attention it merits.

There has been too much of a governmental tendency in recent years to give the West but passing consideration in matters of national concern. Wherever the West has received specific attention its representatives have been united in their demands. Mineral producers in Idaho, Arizona, New Mexico, Montana, Utah, Colorado and California have had the support of mineral producers in Minnesota, Pennsylvania, Michigan, West Virginia, Illinois, Indiana, Arkansas, Tennessee, Kentucky, Alabama and Missouri, and vice versa. The results are seen in the Fordney-McCumber tariff law, in the mining provisions of the income tax law, and in the defeat of numerous proposals that would, if enacted, have tended to handicap the mining industry under a network of regulation and administrative interference.

The American Mining Congress always has welcomed joint meetings such as the Denver meeting. Cooperation among the various agencies and organizations representing the mining industry has proved beneficial in many ways; and will bring desired results, in respect to both existing and new issues, if it is intensified and continued. We have only to point to definite results of the past to demonstrate the wisdom and efficacy of the coming Denver meeting.

PUBLIC LAND LEGISLATION

STRONG sentiment has been crystallized in favor of an early revision of the public land laws; but no definite policy appears to be behind this sentiment. On the contrary, there exists a wide divergence of opinion between the groups affected—the mining industry, the stock-growers, agricultural interests, and the Interior Department.

The western mining industry wants a revision program that will open the doors wider to mineral prospecting and development. The laws relating to the public domain, and policies of government which have been enforced in the administration of these laws, have interfered seriously with mineral development in the western States. The enlarged homestead acts, the various leasing acts, and the land-grant acts have failed to protect adequately the interests of the mining industry.

Stock-growers have been subjected to a leasing system that has caused much enmity and hatred among rival groups, particularly between the cattle and sheep interests. And surface control through Government leases has tended, in many districts, to discourage prospecting for minerals. Possibly the country has incurred no great economic loss by reason of the leasing system. On the other hand, prospecting without interference might reveal just one mineral deposit of greater commercial and economic value than the combined surface value of all the lands leased for grazing purposes in an entire district. The prospector would not interfere with the use of the public domain for grazing purposes, and grazing lessees should not be permitted to interfere with the prospector.

The agricultural interests affected are the dry land farmers and homesteaders. Although the Federal Government reserves the mineral rights in public lands classified as non-irrigable and subject to homestead entry in 320-acre tracts, or as chiefly valuable for grazing purposes and subject to entry in 640-acre tracts, the restrictions imposed upon prospectors who would seek

minerals on such lands, when homesteaded, are practically prohibitive. Bonds are required. The individual prospector, generally without financial backing, seldom has sufficient funds for his grubstake. Then the homesteader may oppose his entry upon the land even if he can furnish the bond, and he is confronted with possible litigation and expense in order to have the General Land Office or the courts determine his rights. What prospector will take such a chance in addition to the long chance he has to take of not finding commercial mineral even if allowed to prospect?

If the Interior Department, in its "comprehensive survey," takes into account all of these conditions in formulating its future policies and recommendations, and places the economic importance of the western mining industry first, constructive legislation may follow, and existing confusion and conflict of interests may be eliminated. But the failure of the Department to give careful consideration to the problems of mineral prospecting in all classified lands where mineral rights have been reserved, and failure to properly provide for the protection of mineral claimants and to permit free and unrestricted prospecting, would only serve to intensify the difficulties now existing and to further hamper mineral development.

In the western States the mining industry constitutes a major source of taxation revenue, furnishes most of the freight traffic for the railroads, provides the principal local markets for agricultural products, and is of paramount economic importance to these States as well as the Nation. The interests of the industry therefore must be placed foremost, and its representatives must subject every proposal for revision of the public land laws to critical scrutiny before permitting any recommendation or bill to reach the floor of either branch of Congress unopposed.

It would be well for the mining industry to prepare and sponsor proposals of its own making, rather than to wait for the Interior Department or the Committees of Congress to act. It would be far better to have proposed legislation on the right basis at its inception rather than to risk the chance of having to correct it after its introduction in Congress. In any event, the western mining industry expects, and will demand, full recognition and protection of its rights in any legislation that may be proposed.

PUBLIC CONFIDENCE HELPS MINING

THE resumption of mining activities throughout the West is indicative of returning healthy conditions and general prosperity. When depression strikes at the heart of business the producer of raw material usually is the first to feel the pinch of financial difficulties and shortage of capital, and usually he is the last to be helped back on the road toward recovery. Thus, we have seen commercial lines of business become stable, followed by recovery of the manufacturing industries. Now the basic industries of mining and agriculture are showing signs of rehabilitation.

There has been an acute shortage of capital for the revival of the western metal mines; but the situation is rapidly improving as public confidence improves. The settlement of back-tax liability in the copper and silver industries has had a salutary effect, and has released large reserves of capital for development and expansion in those industries. And the release of these funds, that have been practically impounded for several years, has helped tremendously in stimulating public confidence in the western mining situation.

Every mining man wants to see capital flow into mining investments. The mining industry is one of the nation's greatest assets. The western States particularly are dependent upon their metal-mining industries. Therefore, these industries should have full encouragement by both State and National Governments. It is incumbent upon the Government not to impose exorbitant tax burdens upon the mines or unduly restrictive regulations in the form of "blue-sky" laws upon the promotion and development of mining enterprises. On the other hand, it is incumbent upon the mine developers and operators not to resort to extravagant claims for the purpose of inducing investors to place their capital in mining ventures.

There recently has come to our attention an assertion that profit to investors from mines is more than six times the percentage of any other industry. Some figures were given to support this assertion. These were sent to the Federal Reserve Bank at New York for comment, and the following reply was received: "We doubt very much whether actual average profits could differ in any such way as these percentages indicate." And a well known financial journal, whose alleged findings were quoted in the article, wrote that "it never made any such compilation nor any investigation warranting such a compilation." We refer to this in order to illustrate how misleading and exaggerated statements in regard to the mining industry do no good, and may seriously harm the industry by creating suspicion and distrust, not only of legitimate promotion projects, but of promising enterprises already developed.

Properly promoted mining ventures do not have to resort to extravagant claims in order to secure capital. The public knows that there is a speculative element in mining just as in any other line of business, even farming. It has been only a short time since the bubble of a great agricultural venture in Indiana burst, an extensive banking system in Georgia went on the rocks of bankruptcy, and a great chain store enterprise had to submit to a receivership; but these isolated failures, notwithstanding their magnitude, have not shaken the confidence of conservative bankers, business men, and investors. Neither does an occasional mining failure cast its reflection upon the whole mining industry.

In every line of business activity there will spring up here and there an unprincipled promoter who expects to get "boob money." The men who stand behind the program and policies of the mining industry are men of high caliber. They are vitally interested in protecting the public against such promoters of mining ventures, just as the bankers and business men of the nation are anxious to thwart get-rich-quick schemes in the banking and commercial fields. Therefore, knowledge concerning the men who are backing any mining venture, is a far safer guarantee against a fraudulent scheme than could possibly be afforded by "blue-sky" laws, however sanely and honestly administered.

Mining is a very practical business. There is no more of a gamble in a mining enterprise, when it is honestly managed and intelligently financed, than there is in any other business. It is frequently highly profitable. The men engaged in the mining industry in general are worthy of the highest public confidence. Their vision, energy and initiative have made the industry successful. The United States Bureau of Mines statistics show that the industry is making tremendous strides in development and expansion, despite the handicaps of high costs and depression during recent years. This is convincing evidence, not only of healthy improvement in the industry, but of well merited public confidence.

THE NATURAL RESOURCE QUESTION

AN EMINENT financier of Germany made public a statement recently, in which he said that the keynote of Europe's rehabilitation—and of its ability to pay off its war debts—is cheap foodstuffs and cheap raw materials.

In the United States the big question today is to find a market for the foodstuffs, which we produce cheaply, and to find a market for the natural resource materials, which we also produce cheaply.

It thus seems to be a question of getting to Europe the things which it needs and which we have to offer. Here is a perfect case of a matched demand and source of supply. At the source the market price is satisfactorily low. At the market end, the price must be equally low. What stands in the way of closing the deal is the cost of transportation.

In our own country some variations of the same situation are beginning to appear. Gradually our producing centers in many things are shifting, as producers move their factories nearer to the source of their raw materials. This is involving nothing less than the tearing up of communities by the roots and moving them bodily into new surroundings. It would be possible to illustrate this by specific incidents, but they are so well known that they need no repetition here. What promises to go on in Europe is exactly what is taking place here. That is, Europe must continue to live in Europe and have its raw material moved to it, or Europe must move where it can get the raw material. The disturbing factor in both situations is the cost of transportation.

This is no new question in American industry. It is no new question in the affairs of the world. The same migration in pursuit of a changing source of raw materials has been in progress for centuries. And the same search for low-cost transportation has been in progress through the same stretches of time. At intervals this subject comes up for discussion. Specifically, it was raised in the early winter of 1921, when our own Interstate Commerce Commission was considering the general level of freight rates.

At that time the American Mining Congress took the position that a natural differential exists between the transportation charges on basic raw materials and finished products. It insisted that the same natural differential should be recognized by the commission and should be embodied in our tariffs. At the same time the same position was taken by Secretary Hoover, who appeared before the commission and gave reasoned testimony in favor of his proposal. Subsequent to that time, the American Mining Congress has insisted upon the essential soundness of its view. Mr. Hoover has, at various times, reiterated his own beliefs. The whole situation has now become acute. Before the next great migratory movement starts, in pursuit of cheap raw materials, the world might well devote some time and attention to the cheap movement of these basic raw materials. It certainly would seem cheaper to move raw materials at a differential rate than it would be to shift the center of gravity of a whole civilization by starting established communities off like a caravan in search of an ever-changing source of supply of cheap raw material.

To a large extent, the subject is again before the Interstate Commerce Commission, which is, at the moment, struggling with both the questions of coal rates and of rates on foodstuffs. It would be a distinct contribution to the future safety of the Nation if the commission could make a beginning—no matter how feeble—toward the establishment of differentials between raw materials and finished products. It might be sufficient at the beginning merely to recognize the principle that a differential should exist. The ensuing years could be spent profitably in the effort to work out those differentials.

WHAT IS THE REMEDY?

ALTHOUGH the entire subject of Federal taxation seems to be open for consideration by the Congressional Joint Commission on Taxation, it is not believed that any effort will be made by that body to modify the basis of the present law in so far as it operates to raise revenue from annual incomes. It is not probable that the Commission will consider seriously any proposal to deviate from the general principles of existing law for the determination of taxable income. The Commission's object primarily will be to work out fairer methods for determination of taxable income, and to recommend changes in the system that will secure a simpler and more equitable administration of the law.

As to the determination of income, Congress has built up, year by year, a more involved structure by writing into each succeeding revenue act more and more of the Treasury regulations and decisions. The reorganization sections, which the American Mining Congress has so vigorously opposed, are the outstanding example of this unfortunate policy.

A satisfactory income tax administration will not be possible until the provisions of law relating to the determination of income are clarified, simplified and made comprehensible to the ordinary taxpayer, who is required by law to swear to the accuracy of his return. To continue on the statute books involved statements of the law such as now exist, with such a conglomerate mass of Treasury regulations behind them that the ordinary taxpayer can not hope to understand the legal definition of net income, is morally wrong and inevitably leads to hopeless conflict between the department and the taxpayers.

The present standard for determination of taxable income is beyond the capacity of ordinary revenue agents and examiners to understand. Consequently there is little hope that the department will ever be able to build up a corps of agents and examiners who are qualified properly to settle disputed items. The most that can be hoped for under the present system is that on the basis of averages sufficient taxation revenue will be collected to sustain the Government. Under this system many taxpayers will fail to pay the full taxes intended by the law and others will pay more than they should due to ignorance of their rights or because the amounts involved are not sufficient to pay the costs of a contest. Such a system could be excused at its inception, but it cannot be considered as a proper basis for a successful, permanent taxing system.

In seeking to improve and simplify the revenue law and its administration the Commission will be unable to take any single step that will eliminate all difficulties; but the two important factors which should be considered are, first, the definition in the law of income which is to be taxed, and, second, the administrative system by which the amount taxable and the amount of tax are to be determined and settled. These are the major points to which attention must be directed if the Commission is to work out a permanent, satisfactory system of determining income-tax liability and collecting these taxes.

TRANSPORTING POWER

SEEN from a philosophical point of view, the essential value of coal, as a source of power, has been that it has freed the user of power from the need to live where the power could be produced. This is reminiscent, of course, of days long since forgotten. That is, the early source of power was the water wheel. That could be operated only on the banks of running streams. This fact tied industry to the banks of running streams and limited it to the power residing in that stream. When coal came along, it was a transportable solid which contained "canned power." That solid could be moved anywhere, and the power which it contained could be liberated at will. To that extent, coal struck off the shackles which bound industry to the banks of running streams.

As we progressed, the cost of transporting the coal itself became so high that many could not afford to use it. This started a movement to transport the power which is latent in coal in the form of power. One method was to convert the coal into electrical energy and transmit that by wire. The other method was to translate the coal into gas and pump it through underground conduits. Many have been so bold as to say that these latter forms will alone be utilized in future.

For that statement they have a groundwork of reasonable assumption, to say the least. It is pointed out frequently that it now costs more to transport a ton of coal by rail to market than, on the average, it costs to produce that coal at the mine, and into the cost of production is computed the operator's overhead and his profit, if any. It frequently is pointed out that it costs more to transport a ton of coal across a city like Washington, by wagon or truck, than to carry it by rail a distance of 400 miles. For this amazing situation the growing value of city real estate and the growing congestion of city streets is directly responsible.

From these facts it is argued that it will prove cheaper in future to transmit the power itself—in the form of gas or electricity—through underground conduits than it will be to move it by rail or by wagon. Up to now, these new forms of transportation have not proved the contentions made in their behalf. Tremendous quantities of electrical energy are being transmitted by wire. But electricity can not be made at the mine mouth, for the reason that the water supply is inadequate. So the coal must be moved by rail at least to the source of water. Then the line loss when transporting electricity is considerable, thus increasing the cost to approximately the level of rail transportation.

Attention recently has been directed toward the translation of coal into gas and the movement of the gas through underground conduits. In favor of such an enterprise is the possibility of extracting other products from the coal which have a value for other purposes far in excess of their value as fuel. But this project is not without its drawbacks. If an attempt were made to move through pipes enough gas to supply the fuel needs of any modern city, the pipes would have to be of such tremendous size that we would find it impossible to make room for them.

In recent years attention has been given to the possibility of converting the coal first into a gas and then into a liquid. A German chemist, for example, has found it possible to use a catalytic action and translate carbon monoxide into wood alcohol. This is a fuel but it has such a low heat value that its use is prohibitive. The German experiment has inspired American chemists, who now claim to have found a catalytic action which will convert water gas into methane, which can be precipitated in the form of a liquid approaching benzol in heat value. All of these processes are still in the laboratory and have not appeared in the form of commercial plants. Still, they are the creeping actions which edge toward the ultimate achievement. And it is possible that in these direction will lie in future the solution of our problem of transmitting power.

LEVELS OF PROSPERITY

ACCORDING to the Yearbook of the Department of Commerce, the United States in 1925 reached the "highest levels ever attained in our history, not even excepting the years of abnormal war activity." This is perhaps difficult for us, living so close to it, to realize. But the fact remains that we have been living in the most prosperous, the most advanced age of our history.

What is the secret of this amazing prosperity. The answer is a subject that is now engrossing a goodly portion of the world. Britain recently sent a commission to America to study conditions and to ascertain why it is that we are able to pay our workmen an average of $8.50 per day, while she pays hers $2.00. Its report has given much credit to the mechanization of our industries, with the consequent elimination of hand processes. An Australian commission is to visit this country shortly whose special mission is to study American industrial methods. In Germany, we are informed, they are rapidly adopting American industrial ideas and equipment. Even Communist Russia has sent missions of inquiry to our shores.

The New York Times very ably put the answer to these inquiries when it said, "Mass production at maximum efficiency, plus low prices, plus high wages, leads to large profits—a complete reversal of the old idea that profits were made by charging as much as possible and paying labor as little as it would stand."

The Department of Commerce gives the following reasons for America's greatness in industry: "Greater efficiency of wage-earners themselves, improved management, more scientific methods of waste elimination."

Speaking for conditions in the mining industry, the greatest strides have been made by those who have taken full advantage of mechanical appliances.

This national prosperity is reflected in the mining industry. Colorado is opening both old and new mines; Utah has been high in production and dividends; Arizona, New Mexico and Montana are prosperous mining States; Nevada is giving attention to her possibilities as a lead and zinc producer, while not diminishing her output of gold, silver and copper; Idaho in 1925 spent approximately $7,500,000 in developing her mineral industry; the Tri-State District is operating between 155 and 175 mills; sections of the coal industry not harrassed with labor difficulties are producing large tonnages. Other sections of the coal industry are on the verge of bankruptcy in spite of the fact that coal is perhaps far in the lead of all the minerals where mechanization is concerned. And coal, in spite of its difficulties, is giving to the country the cheapest power and the cheapest fuel known to the world.

The mines of the country have more than a million employes. The payroll of the mines is a big part in industrial prosperity and their huge wage bill is the backbone of hundreds of thriving communities.

A large percentage of American prosperity rests with its mineral producing industries. They reflect in general the tendency of the nation. And mining is on the up-grade.

WESTERN DIVISION AMERICAN MINING CONGRESS MEETS

Annual Meeting Western Division American Mining Congress To Be Cooperative Affair—Splendid Program Arranged Covering Many Phases Of Western Problems—American Institute, Silver Association And Rocky Mountain Geologists Also Holding Sessions

THE American Mining Congress, long a leader in all cooperative movements in the mining industry, will bring together at Denver, Colo., during the week of September 20, practically all phases of the western mineral industry, when its Western Division will hold its annual convention at the Cosmopolitan Hotel. The American Institute of Mining and Metallurgical Engineers, the American Silver Producers Association, and the American Association of Petroleum Geologists, each will join with the Western Division in making the sessions highly constructive and of the greatest value to western mineral producers.

The meeting will be under the direct auspices of the Western Division, The American Mining Congress, of which the Hon. Jesse F. McDonald, former Governor of Colorado, and president of the Downtown Mines Co., is chairman. M. B. Tomblin, Secretary of the Colorado Chapter, The American Mining Congress, and secretary of the Colorado Metal Mining Fund, is Secretary of the Division. Ten mining states are represented by the Board of Governors, which is composed of the following states and representatives:

Arizona—Robert E. Tally, United Verde Copper Co., Jerome, Ariz.; W. B. Gohring, 419 Heard Building, Phoenix, Ariz.

California—Robert I .Kerr, 509 United Bank & Trust Co. Bldg., 625 Market St., San Francisco; P. C. Knapp, Natomas Co. of Calif., San Francisco.

Colorado—Jesse F. McDonald, Denver, Colo.; M. B. Tomblin, 437 State Office Building, Denver, Colo.

Idaho — A. P. Ramstedt, Wallace, Idaho; Ravenel Macbeth, Idaho Mining Association, Wallace, Idaho.

Nevada—Henry M. Rives, Nevada Mine Operators' Assn., Reno, Nev.

New Mexico—John M. Sully, Chino Copper Co., Hurley, N. M.; Jos. Woodbury, New Mexico Chapter, The American Mining Congress, Silver City, N. Mex.

Oregon—Robert M. Betts, Cornucopia Mining Co., Cornucopia, Oreg.

South Dakota—B. C. Yates, Homestake Mining Co., Lead, S. Dak.

Utah—V. S. Rood, Utah Apex Mining Co., Bingham, Utah; A. G. Mackenzie, 212 Kearns Building, Salt Lake City, Utah.

Washington—Raymond Guyer, Symons Building, Spokane, Wash.

The convention will open on the morning of September 20, at the Cosmopolitan Hotel, followed by a luncheon to the delegates by the Board of Governors of the Western Division. Mr. McDonald will act as chairman of the afternoon session, which will feature addresses by the Hon. Hubert Work, Secretary of the Interior, and Representative Charles E. Winter, of Wyoming, who will discuss the public lands question.

Jesse F. McDonald, Chairman, Western Division, The American Mining Congress

Official Washington, especially that part of it which directs the administration of laws and regulations in respect to the public lands, will be well represented at the meeting. Among the Government officials who will attend are: Dr. Hubert Work, Secretary of the Interior; Dr. Scott Turner, director, United States Bureau of Mines; Hon. William Spry, commissioner, General Land Office; Hon. W. B. Greeley, chief forester, United States Forest Service; W. C. Mendenhall, chief geologist, United States Geological Survey; C. H. Birdseye, chief topographer, United States Geological Survey; G. F. Loughlin, chief, Division Metalliferous Geology, United States Geological Survey; and M. J. Gavin, refining engineer, United States Bureau of Mines.

The silver situation will be considered at the morning session on September 21, when W. Mont Ferry, managing director, Silver King Coalition Mines Co., Salt Lake City, Utah, will preside. This session will be under the auspices of the American Silver Producers Association.

As a result of the proposed adoption of the gold standard by the Government of India, the political and economic unsettlements in China, and the demoralization of European currencies, together with the slow recovery of economic conditions, silver producers are confronted with conditions more unsatisfactory than at any time within the present century.

In consequence, western silver producers are looking forward with much interest to the meeting of the Board of Directors of the American Silver Producers Association, which will be held during the convention.

The American Silver Producers Association membership represents about 85 percent of all the silver produced on the American continent. For the past two years this organization has been gathering first-hand information in the United States and foreign countries respecting the silver situation, and has assembled for consideration more direct and vital facts bearing on this question than has ever been compiled before by any governmental or private agency.

At the forthcoming meeting of the Board of Directors the Executive Committee will make recommendations embracing conclusions as to what the organization and its members should do to meet present conditions of the industry.

Following the action of the Board of Directors at their meeting which will be held on the 20th, Mr. F. H. Brownell, first vice president of the American Smelting and Refining Co., and chairman of the Executive Committee of the Silver Producers Association, will, on Tuesday morning, September 21, address the joint meeting on the subject "What Can Be Done for Silver?"

Probably no man in this country is better posted on this subject than Mr. Brownell, and the conclusions of the Board of Directors and the address of Mr. Brownell are awaited with much interest not only by silver producers of this country but the entire world.

The members of the Board of Directors of the Silver Producers Association are:

W. Mont Ferry, managing director, Silver King Coalition Mines, Co., Salt Lake City, Utah.

W. J. Raddatz, president, Tintic Standard Mining Co., Salt Lake City, Utah.

Charles Bocking, general manager, Butte and Superior Mining Co., Butte, Mont.

A. M. Morris, Phelps-Dodge Corporation, Tombstone, Ariz.

L. O. Evans, general counsel, Anaconda Copper Mining Co., Butte, Mont.

Robert E. Tally, general manager, United Verde Copper Co., Jerome, Ariz.

Alfred Harrell, president, California Rand Silver, Inc., Bakersfield, Calif.

John G. Kirchen, general manager, Tonopah Extension Mining Co., Tonopah, Nev.

Clyde A. Heller, president, Tonopah Belmont Development Co., Tonopah, Nev.

Frank M. Smith, smelter director, Bunker Hill and Sullivan Mining and Concentrating Co., Spokane, Wash.

Jesse F. McDonald, president, Colorado Mining Assn., Leadville, Colo.

Jerome J. Day, president, Tamarack and Custer Consolidated Mining Co., Wallace, Idaho.

C. F. Kelley, president, Anaconda Copper Mining Co., New York City.

F. H. Brownell, first vice president, American Smelting and Refining Co., New York City.

F. Y. Robertson, vice president, United States Smelting, Refining and Mining Co., New York City.

In a statement to the press concerning the silver situation, M. B. Tomblin, Secretary of the Western Division, said:

"With the American Government already loaded down with silver, leaders among the producers are reaching the opinion that hope of salvation does not lie in governmental aid.

"Stabilization of silver has been the chief desire of the industry, the most popular suggestion being that the value of silver be fixed by law—16 ounces of silver to equal in value 1 ounce of gold.

"During the World War England needed silver badly for use in India, where paper money was causing unrest among the natives and proving a fertile field for German propaganda. That need resulted in the purchase of 360,000,000 ounces of silver from this country. Congress passed a bill providing that every ounce the American Government sold England under the agreement should be replaced by purchase of American silver.

"The Pittman Act, which will again be before Congress this fall, provides for the purchase of 14,000,000 ounces more by the Government, the amount producers say the Government is behind in replacement of the silver sold to England.

"Some producers believe the Pittman measure to be only a temporary relief, and that they must go deeper in order to get to the foundation of the industry's troubles.

Hubert Work, Secretary of the Interior

"Some producers point out that silver has only two uses—in the arts and as subsidiary coinage. They believe solution of their difficulties lies in creating a greater demand for silver in those two fields. In the arts they propose a gigantic, nation-wide advertising campaign to popularize the use of silver plate in every possible form. To increase the use of silver coin, these producers would agitate for use of as much as possible by the American Government, but would conduct an intensive campaign to get more foreign governments to use silver as subsidiary coin, replacing much of the small-denomination paper money now in use.

"Among the smaller and newer European countries that suggestion is expected to find the most favor and, its backers believe, would do much to stabilize and readjust the finances of those countries.

"This latter plan of increasing consumption in the arts and for subsidiary coinage is expected to be the recommendation of the association's investigators."

A luncheon will follow the session devoted to the problems of the silver producer.

The American Association of Petroleum Geologists will conduct the afternoon session on September 21, which will be presided over by Alexander W. McCoy. This session will consider questions concerning the geology of western Kansas, Oklahoma and Texas.

Sessions of the American Institute of Mining and Metallurgical Engineers will be held morning and afternoon on September 22, with John W. Finch presiding over the morning session and Charles W. Henderson over the afternoon session. At the morning meeting addresses will be delivered by Dr. H. Foster Bain, secretary of the Institute and former director of the Bureau of Mines; Scott Turner, director of the Bureau of Mines; M. F. Coolbaugh, president of the Colorado School of Mines on the progress of leaching and electrolytic metallurgy; Prof. A. J. Weinig, superintendent of the experimental plant of the Colorado School of Mines; and M. J. Gavin, refining engineer of the Bureau of Mines. Following these addresses a luncheon will be tendered the directors of the Institute.

During the morning petroleum geologists attending the convention will make a trip to the Fort Collins oil fields.

At the afternoon session addresses will be made by Director George Otis Smith of the Geological Survey; W. C. Mendenhall, chief geologist of the Geological Survey on the Colorado cooperative survey; G. P. Loughlin, chief of the Metallurgical Geology Section of the Geological Survey on the ore deposits of the Cripple Creek, Colo., District, and C. H. Birdseye, chief topographer of the Geological Survey on topographical mapping. A dinner in the evening will conclude the day's program.

Secretary James F. Callbreath of the American Mining Congress, will preside over a meeting of the Western Division on the morning of September 23, for which speakers are being selected.

Among the topics to be considered by this session will be the policy of the National Government regarding the holding or disposition of public lands, particularly as affecting the mining industry.

Secretary of the Interior Dr. Hubert Work, who will address the convention, says:

"I do not believe in piecemeal legislation covering mining on public lands, leasing of coal, potash and kindred material, together with oil and oil shale, which has injected itself into the administration of public lands in recent years, or grazing on the public domain, will meet the situation without embarrassing administration, but they should all be comprehensively considered at the same time and a comprehending policy defined, so that the different activities should not be thrown in conflict with each other by special legislation enacted in their interests. Your proposed conference will be a welcomed opportunity to present those tentative suggestions to those who have views born of experience on these important questions. I shall see to it that this department is represented at that meeting—by myself, if possible."

Another question for consideration and discussion will be the leasing act as affecting the public land states. Has its operation proven generally beneficial to the western states? Have the benefits to the states in which Federal lands are located compensated for the loss suffered on account of the withdrawal of coal, oil and shale lands from private ownership, which would otherwise be a taxable asset for these states? Should the present tendency of Congress to extend the provisions of the leasing act, and to foster further withdrawals of public lands, be encouraged or resisted, and have the states a sound basis for resistance? Is it a fair and equitable distribution of the funds derived from royalties under the leasing act that 37½ percent should be returned to the states from which they were derived; 10 percent to be retained at Washington for administration expenses, and 52½ percent devoted to reclamation projects for agricultural purposes?

It is proposed that this question, like all others that may come before the meetings, shall be taken up in a broad-minded way for the purpose of developing all possible information on which to base conclusions as to what is best for all concerned—the Nation, the state, and the mining industry.

Secretary Work of the Interior Department will speak for the Government. Congressman Charles E. Winter of Wyoming, will speak upon the leasing act as it affects the public land states; and ex-Land Commissioner Clay Tallman will treat the subject from the viewpoint of the operator.

Secretary Hoover is expected to address the convention upon current issues affecting the mining industry as presented to the United States Department of Commerce.

Thursday afternoon will be devoted to a trip to the experimental plant of the Colorado School of Mines at Golden, going over Lockout Mountain, concluding in the evening with an Elk barbecue and basket dinner at the Motor Club and terminating in dancing.

On the same morning a meeting of the American Association of Petroleum Geologists will be held to consider Rocky Mountain geology, with Alexander W. McCoy, presiding.

© Harris & Ewing

Scott Turner, Director, U. S. Bureau of Mines

The convention will end on September 24 after a morning session of the Western Division with Mr. McDonald presiding. At this meeting resolutions will be adopted expressing the opinion of the delegates on matters of policies.

Throughout practically all of the western states during the past year there has been a most decided revival of mining activity. Research, development and general interest in mining has probably been more widespread than during any like period in the history of the industry. As a result of new and improved metallurgy, scientific development and an increasing demand for metals, oil and other mine products, the western mining states undoubtedly stand at the threshold of a new period of mining development and production. In consequence, new problems are confronting the operator and united and concerted action of all those engaged or interested in the development of the mineral resources of the West is, and will continue to be, more imperative than ever before.

Confronted with a situation following the war which threatened disaster to the industry, mining men took up their problems with the same vision and courage which actuated the sturdy band of pioneers and prospectors, who, a generation before this, peopled the great West. With a determination that would not be denied, the same spirit of adventure, aided by modern science, is now developing the mineral resources of this great territory, and, adjusting operations to meet existing conditions, is removing the obstacles which for a time have barred the way to normal activity.

Through organization and cooperative effort, by research and active development, the adoption of improved metallurgy and operating equipment, by combatting discriminatory and unfavorable legislation, by stimulation of markets through fostering a wider use of mineral products, and with the help of associated or allied industries, the mining industry is making an amazing recovery, and throughout all the mountain states, there is an outstanding promise of a new era of mining activity.

The convention promises to be of vast importance to western mining.

Studies recently completed by engineers of the Bureau of Mines attached to the bureau's experiment station at Pittsburgh, Pa., have demonstrated that voice signals can be transmitted in and out of a mine through more than 400 feet of underlying strata by the use of dry cells as a source of electrical energy and modified telephone parts as receiving and sending apparatus. The feasibility of conducting a conversation through considerable depths of earth strata has been proven. Further experimentation is needed to determine the best methods of applying these principles.

Telluride, Colo., as Seen From the Road to Tomboy

Tentative Program

JOINT CONVENTION

WESTERN DIVISION, AMERICAN MINING CONGRESS
AMERICAN INSTITUTE MINING & METALLURGICAL ENGINEERS
AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS
AMERICAN SILVER PRODUCERS ASSOCIATION
DENVER, COLORADO SEPTEMBER 20-24, 1926

MONDAY, SEPTEMBER 20

Forenoon

Registration of Official Representatives, Delegates and Members at Cosmopolitan Hotel.

10.00 A. M. Directors Meeting, American Silver Producers' Association.

LUNCHEON—Board of Governors, Western Division, American Mining Congress.

Afternoon Session

1.00 P. M. Western Division, American Mining Congress.
HON. JESSE F. MCDONALD, Presiding.
Addresses:
HON. HUBERT WORK, Secretary of Interior.
HON. WILLIAM SPRY, Commissioner of General Land Office, "The Public Domain."
HON. C. E. WINTER, Representative from Wyoming, "Public Land States and Federal Government."
Discussion.
DINNER—Committee Meetings.

8.15 P. M. Get Together Meeting—Smoker—Entertainment by Joint Organizations.

TUESDAY, SEPTEMBER 21

Forenoon Session

9.00 A. M. American Silver Producers Association.
W. MONT FERRY, Presiding.
Address:
F. H. BROWNELL, First Vice-President, American Smelting and Refining Co., "What Can be Done for Silver?"
Discussion.
LUNCHEON—Committee Meetings.

Afternoon Session

1.00 P. M. American Association of Petroleum Geologists.
ALEX. W. MCCOY, Presiding.
Addresses:
M. M. VALERIUS, Discoverer of the Russell Field in Russell County, Kansas, "Geology of Western Kansas."
J. V. HOWELL, Geologist, Marland Oil Company of Colorado, "Geology of the Amarillo District."
J. W. BEEDE, Chief Geologist, Dixie Oil Company, "Geology of Southwestern Texas."
DINNER—Committee Meetings.

Evening

Committee or Other Meetings.

WEDNESDAY, SEPTEMBER 22

9.00 A. M. Petroleum Geologists Trip to Fort Collins Oil Fields.

Forenoon Session

9.00 A. M. American Institute of Mining and Metallurgical Engineers.
JOHN WELLINGTON FINCH, Presiding.
Addresses:
H. FOSTER BAIN, Secretary, A. I. M. M. E.
SCOTT TURNER, Director, U. S. Bureau of Mines.
M. F. COOLBAUGH, President, Colorado School of Mines, "The Progress of Leaching and Electrolytic Metallurgy."
PROF. A. J. WEINIG, Supt. Experimental Plant, Colorado School of Mines.
M. J. GAVIN, Refining Engineer U. S. Bureau of Mines.
LUNCHEON—Directors A. I. M. M. E.

Afternoon Session

2.00 P. M. American Institute of Mining and Metallurgical Engineers.
CHARLES W. HENDERSON, Presiding.
Addresses:
GEORGE OTIS SMITH, Director U. S. Geological Survey, "The Ever New West."
W. C. MENDENHALL, Chief Geologist U. S. Geological Survey, "Colorado Cooperative Survey."
G. F. LOUGHLIN, Chief of Metallurgical Geology, U. S. Survey, "Ore Deposits of Cripple Creek."
C. H. BIRDSEYE, Chief Topographer, U. S. Geological Survey, "Topographical Mapping."
DINNER.

8.00 P. M. Address: AUGUSTUS LOCKE. "Ore Finding."

THURSDAY, SEPTEMBER 23

Forenoon Session

(Duplicate Meetings, American Mining Congress—Petroleum Geologists)

9.00 A. M. Western Division, American Mining Congress.
JAMES F. CALLBREATH, Presiding.
Addresses:
W. B. GREELEY, Chief Forester, U. S. Forest Service, "Mining in National Forests."
FRANK L. HESS, Chief Engineer, Minerals and Metals Division, U. S. Bureau of Mines, "Rare Minerals."
LUNCHEON.

1.00 P. M. Trip to Experimental Plant, Colorado School of Mines, Golden. Trip Over Lookout Mountain to Denver Motor Club.

6.00 P. M. Elk Barbecue and Basket Dinner—Motor Club—Dancing.

THURSDAY, SEPTEMBER 23

Forenoon Session

(Duplicate Meetings, American Mining Congress—Petroleum Geologists)

9.00 A. M. American Association of Petroleum Geologists.
ALEX. W. MCCOY, Presiding.
Addresses:
R. C. COFFIN and T. S. HARRISON, "Rocky Mountain Geology."
LUNCHEON.

2.00 P. M. American Association of Petroleum Geologists.
ALEX. W. MCCOY, Presiding.
Addresses:
DR. BAILEY WILLIS, Geologist, "The Structure of the Coast Range and Its Relation to the Rocky Mountain Province."
C. A. FISHER, Geologist, "Geological Reconnaissance of Western Canada, and Its Importance to Future Development."

Following adjournment of session cars will be provided to take members to Barbecue at Motor Club.

6.00 P. M. Elk Barbecue and Basket Dinner at Motor Club—Dancing.

FRIDAY, SEPTEMBER 24

Forenoon Session

10.00 A. M. Western Division, American Mining Congress.
JESSE F. MCDONALD, Presiding.
Report of Resolutions Committee.
Unfinished Business.
Adjournment.

RESEARCH WORK IN THE COPPER INDUSTRY

Copper And Brass Research Association Unique Among Organizations In That It Represents Both Producer and Consumer—Its Activities Cover A Vast Field—An Outline Of What It Does And What It Has Accomplished

By WILLIAM A. WILLIS *

PRIOR to the formation of the Copper & Brass Research Association the various elements which now comprise that organization were inclined to go it very much alone. The copper mining companies mined, smelted and refined their copper, cast it into commercial shapes, sold these in the open market and apparently forgot them. The rolling mills, or fabricators, who are the initial consumers of all copper, bought this copper, rolled or drew it into the form of sheets, tubes, rods and wire of both copper and copper alloys, and passed it on to the manufacturers. These latter cut, spun or stamped the metals into the many thousands of articles normally manufactured of them and passed them along to the public.

For many years there was a nice comfortable business conducted along these lines despite the fact that copper metal was very much of an orphan. Consumption ate up about all the mines produced, prices were reasonably fair, there were no clouds on the horizon. If you had gone into Arizona, Montana or the northern Michigan peninsula in those days and hinted that copper might some day be up against it, you would have been regarded as slightly "loco." Those were the glorious days when the producer had little concern about his copper once he had sold it, when the mills dropped their interest in their sheets, rods, tubes and wire, once they had unloaded them on the manufacturer. There was no cohesion, no "follow through" policy, no need of such things.

Then came the war and more prosperity than ever for the copper and brass industries. Europe began clamoring for American copper to make ammunition to fight the Germans. Then the United States got into things and pretty soon about every ounce of copper that could be produced was needed for war materials for ourselves and our allies. Copper and its principal alloys, brass and bronze, promptly departed from commerce. Mining and mill facilities were expanded to hitherto undreamed of proportions to meet the ever increasing demand.

Came the armistice and with it chaos. Away flew the government guaranteed price for copper. Overnight the demands on the mills ceased. In materials on hand, in scrap, etc., there were perhaps a billion pounds of copper, produced, at abnormal cost, available for immediate consumption. But who was to consume it? War had ceased its toll on the industry and so industry turned its face toward commerce only to find that while it had been away its place had been taken by substitutes, many of them excellent materials, which did not propose to be dislodged without a fight.

It was a gloomy situation. Of what use to mine more copper with millions of pounds available on the ground? Obviously this would have to be absorbed before new copper could be profitably produced. But where was it to be absorbed with domestic markets gone and Europe too stone broke to buy a pound of anything?

William A. Willis

Production as represented by the mining companies and consumption as represented by the mills, suddenly discovered that they were comrades in distress. And so representative groups of these main wings of the industry held a pow wow. It was a perfectly legal and proper council and out of it grew the very wise decision to join hands in a thorough survey of the situation with a view to determining just what should be done to put copper back on it feet. Right here was the birth of the Copper & Brass Research Association, although it was not until more than two years later, in the latter part of 1921, that it actually saw the light of day as a working organization.

It is worthy of note, however, that since that day in 1919 when production and consumption came together for the first time to discuss a common woe, they have never parted company. The coalition has continued without at any time disturbing competitive conditions in either group and has prospered without governmental or other aid. Starting at scratch with an unprecedented surplus to be absorbed, with mines closed down, with mills partially idle and expanded by war demands too far beyond normal capacity, with old markets occupied by others, the industry has slowly but surely worked its way back and today stands firmly on its feet gazing into a future which seems at this time to be very bright indeed.

It is interesting to note the growth of domestic consumption of copper over this period that I have mentioned. The following gives the figures concisely:

Year	Domestic Shipments
1921	614,520,000 pounds
1922	1,099,894,000 pounds
1923	1,471,042,000 pounds
1924	1,506,678,000 pounds
1925	1,662,242,000 pounds

The average monthly rate of domestic shipments for the current year (1926) based on the first seven months has been 151,312,000 pounds. If this rate is maintained for the balance of the year domestic shipments for 1926 will reach 1,815,744,000 pounds, a new high level.

The figures which I have given are not my own. They are those of the American Bureau of Metal Statistics. The Copper & Brass Research Association is not a statistical organization, although it endeavors to check up increased consumption of copper, brass and bronze in specific industries and has been able to do so with a fair degree of accuracy.

This steady growth of domestic consumption has to a large extent solved one of the greatest problems that faced the copper mining and fabricating industries after the war. This was how the tremendously expanded facilities for production, necessitated by war demand, were to be employed in peace times. The American people have taken care of this by demanding more copper and copper products than in earlier days it was ever dreamed they could consume. Europe, considering all the circumstances, has done its share, but without the domestic demand that began to heavily manifest

* Manager, Copper & Brass Research Association.

itself in 1923, the industry was certainly heading toward a point where only the strongest could survive.

A number of factors may be credited with important parts in the development of domestic consumption. First and foremost is that we cannot live up to our accustomed scale of luxurious convenience without copper. Our means of swift communication and rapid transportation are dependent on this metal, as are scores of other things that we daily enjoy. Following the war came tremendous expansions in the electrical, building and other industries which had been more or less stagnant while the world was battling. When capital found that copper and copper products could be purchased at almost pre-war levels it didn't hesitate to use it in preference to other metals. And so an abundance of cheap copper played its part in the rehabilitation of the industry.

These two factors—actual need of copper, and plenty of it at a reasonable price—have been strengthened to a considerable extent by the work of the Copper & Brass Research Association. Here is a body made up of two groups—producers and consumers. Among so-called trade associations I know of none which has a membership of this character, because in the very nature of things such groups are accustomed to looking askance at one another. Within their own ranks each of these groups is highly competitive, more so at the present time than when the association was formed five years ago. Yet there has never been a serious difference of opinion concerning the association and its work among its members, and today with 27 producing members and 19 fabricating members the association represents more than 90 percent of the mine and mill industries in the United States and is stronger in personnel than at any previous time.

The activities of American trade associations vary considerably. Some are almost entirely statistical; others deal with internal affairs; still others are mere merchandising bodies. The Copper & Brass Research Association deals solely with consumption and, of course, with problems which are collateral to that objective. It makes no intrusion into the affairs of its member companies, it works for the industries it represents as a whole, leaving it to the individual members to lay their own plans for getting a fair share of the business which it is able to create.

The American public is amazingly responsive to honest promotional work. Any reputable industry which is clever enough to get its message across to the public may be assured of a receptive audience. When you start out to sell copper, brass, or bronze, you are dealing with a commercial commodity which represents a higher initial cost than some other commodity, which has perhaps in the past served the consumer to his entire satisfaction. You can not get such a consumer to use your metals at a higher price unless you can show him some mighty good reason why he should. In the case of copper and its alloys there are many good reasons why their use is preferable to that of iron or steel. First and most important is that they will not rust. Again their life is practically everlasting, their service uniform in character, and when properly installed they require neither upkeep nor replacement.

Because of these things it takes only a simple calculation to prove that while a copper roof or a brass pipe may cost you more than roofing or pipe of some other materials, you begin to get this differential back in from three to five years, and as time goes on the soundnes of paying a higher price at the outset becomes more and more apparent. Not only in the case of copper and its products, but in a number of other quality materials, the American people have learned this lesson. It has been a good lesson, too, because it has put an end to many evils, not the least of which is the old-school type of speculative builder.

As recently as 10 or 15 years ago, the average home of this type would be well on the way toward crumbling before the owner got it more than half paid for. You can not sell the American buyer this type of home nowadays. The educational work of our association and of other bodies has taught him to be wary. We have in our files the testimony of scores of builders that they can not sell houses unless in certain features, such as leaders and gutters, plumbing systems, hardware, etc., quality materials are used. It is a well-known fact, too, that the great life insurance companies and other dispensers of capital for building purposes, will no longer lend money unless certain specifications concerning materials which they impose are met. And it is a tribute to collective effort by industries that almost all of the materials which high finance insists on having used in ventures it is backing are those which have been promoted by association effort.

It is impossible for me to tabulate the activities of the Copper & Brass Research Association, because new things come up every day. We are in fields right now that we never dreamed of entering five years ago, and five years from now we will doubtless be in activities that up to now haven't even occurred to us. However, our work may be summed up as:

Educational work through advertising in newspapers and national magazines, and the issuance of literature of both a technical and lay character, commercial and technical research, cooperation with dealers throughout the country and good-will effort among the trades and professions having a bearing on the consumption of our metals through personal contact, literature and advertising in the trade, technical and professional press. These activities cover a vast field and each one of them has innumerable ramifications.

Our educational work aimed at the man on the street is a parallel effort to our good-will work among the important trades and professions. Either activity taken alone would not amount to much, and even taken together they would not be wholly effective but for the dealer cooperation which we have built up. For instance, you may very thoroughly sell a prospective home builder on the use of copper for flashings, for gutters and downspouts, for brass pipe in his water lines, and for brass and bronze in his hardware, but when he begins to talk about plans with his architect and plumbing with his plumber forces come in which must be reckoned with. A friendly and fair attitude is essential or your man is likely to be talked out of the convictions he came to after studying your advertising and your literature. Again, even if you have won the home builder, his architect, and his plumber, there is the dealer to be considered. A man who is going to build a home is notoriously impatient. He doesn't want delays, and if he can not get copper for his leaders and gutters promptly, and at a fair price, he is very apt to turn to something else. And so we have had to work among dealers to get them to carry adequate stocks. This we have been able to do by convincing dealers that the hundreds of thousands of dollars we spend in advertising and in generally promoting the interests of copper and copper products means the building of business for them at no cost to themselves. In the main, dealers are receptive to this kind of cooperation and today we enjoy association contact with aproximately 75,000 retail handlers of our metals in the United States and Canada.

Prices, of course, are outside of any activity of ours. Trade associations are barred by Federal statute from this field. The average dealer, however, soon learns that volume sales at reasonable profits are much more lucrative to him than an occasional sale at exorbitant profit, and today there is hardly a community in the United States where our metals can not be obtained in almost any form at a fair figure.

One of the most effective branches of the Copper & Brass Research Association is its building service department. Its function may be summed up by saying that it assists home owners and pro-

spective builders in solving the many vexatious problems which confront them. It answers all questions which do not require investigation beyond its facilities and, while it does not undertake to prepare plans, it is prepared to write specifications for installation of, and otherwise advise on specific uses of copper, brass, and bronze in buildings.

This is a work which has been of inestimable value to the copper industry. Before the organization of the association there was no place for a user of our metals to take his problems. The result was that a failure of copper and brass in service meant the abandonment of these metals by the sufferer and the creation of a hostile frame of mind, which could be very damaging. A failure of copper or brass in service means just one thing—faulty installation. Certain simple rules have to be followed in the application of our metals. You can not nail down a copper roof because expansion and contraction will tear it to pieces, yet before our textbooks were issued for the guidance of sheet-metal workers it was not at all uncommon for such things to occur. You can not put in brass pipe with iron or steel fittings without danger of setting up galvanic action, which speedily destroys the iron or steel. Yet this, too, was a common practice until we issued a technical book of instruction for plumbers, which, I am happy to say, has now become authoritative.

There isn't the shadow of an excuse for a faulty application of copper or brass today, because our technical books on this subject have been placed in the hands of every architect, every plumber, and every sheet-metal worker in the United States. The effect of this kind of work has been most marked. Take the case of plumbing pipe. Here is a field in which I may say with moderation that the competition is bitter. In 1921 the consumption was round 3,000,000 pounds. Today it is running at the rate of about 70,000,000 pounds a year and growing every month. Within a year the association has been actively promoting the use of either copper or brass pipe for services, meaning the pipe which connects the water main with the building, and already half a dozen cities in the United States have adopted one or the other.

In the washing-machine industry, in radio and automobile manufacture, in insect screen cloth, in electric refrigeration, in range boilers, in lighting fixtures, and a score of other industries the consumption of copper is going steadily upward. Before the formation of the association these relatively small consumers were largely ignored. Their consumption, compared to the total, seemed too insignificant to warrant attention, and there was no organized effort behind them. Today their total tonnage is something to be reckoned with, and they present potentialities which are most attractive.

If association work is to be made a real selling force, those conducting it must be eternally vigilant. It is not enough to protect the markets you have got; new outlets must be discovered and developed. That success or failure can be influenced by apparently slight circumstances is shown by the following incident:

Early last year we decided that something might be done to increase the use of copper in lightning rods. Absolutely no promotional work had ever been done in this industry. We made a survey of the situation and discovered, on reasonable estimates, that here was a potential market for the consumption of about 480,000,000 pounds of copper. We prepared a booklet on copper lightning rods and more than 400,000 of these were distributed in farming communities by lightning rod manufacturers. This effort was strengthened by some advertising in farm papers.

Results began to accrue; nothing startling, but enough to show us that we were in a live field. Then a little thing happened that might easily have been overlooked, but which happily was not. The newspapers carried a brief dispatch stating that lightning had struck a barn of the Claiborne Stud at Paris, Ky., and among the casualties was Bonnie Mary, dam of many famous race horses. Immediately we tabulated all of the great horse-breeding establishments in the country, sent literature to their owners calling attention to the fate of Bonnie Mary, and began advertising in the principal periodicals devoted to the breeding industry. The lesson was an obvious one. Bonnie Mary, a dam worth $50,000, and a number of other valuable brood mares which were killed, were housed in a barn that had no lightning-rod protection, although such protection could have been secured for all time for about $150 a building.

The reaction was almost instantaneous. We were deluged with inquiries from breeders asking where they could get the best lightning rods of copper. Complete lists of manufacturers were sent to them and orders began to pile in. As an example of the impetus given to copper consumption in lightning rods by this incident, I quote the following from a letter recently received from the W. C. Shinn Manufacturing Co. of Chicago:

"We have sold to Mr. Hancock lightning rods for 30 large buildings at Paris, Ky., and six large buildings at Charlottesville, Va. We have also sold material to Mr. Barbee of Paris."

And this from a letter just received from Dodd & Struthers, of Des Moines, Iowa:

"We are rodding the new barn on the Calumet farm. We have rodded several hundred other buildings in Kentucky this past year."

Before we entered this field the consumption of copper in the lightning-rod industry was about 15,000,000 pounds a year. This year it will be upward of 20,000,000 pounds and growing steadily. Our contention is that no consumption is too small to warrant neglect. The 1,000,000-pound consumer of 1926 may be a 10,000,000-pound consumer in 1927, and when you add these so-called small consumers together you get a very formidable tonnage indeed. A few score of these smaller consumers lined up behind such enormous consumers as the electrical and building industries means steadily increasing absorption of the products of the mines and the mills, and it is certainly comforting to note each year how the demands of these smaller consuming industries grow.

The research work of the Copper & Brass Research Association is constantly expanding. In cooperation with Columbia University, the University of Illinois, the Engineering Foundation, the National Research Council, the Bureau of Standards, and other governmental agencies we are engaged in research which will be of the greatest value to our industry. To give any adequate idea of the scope of this particular effort would require another article. Such work is of a continuing nature and in most cases extends over years of time. We are happily approaching the end of our experiments with locomotives equipped with copper fire boxes and boiler tubes and with copper-protected marine piling, and from this work we anticipate good results in the way of increased consumption.

In conclusion, I want to say that such measure of success as the Copper & Brass Research Association has met with has been due in large part to the earnest cooperation of the member companies and their technical staffs with the association personnel. For five years it has been a case of all pulling together in a common cause.

COAL ECONOMIST

Applications will be received by the Civil Service Commission until September 28 for appointment as assistant business economist on coal in the Bureau of Mines at $2,400 to $3,000 per year. Applicants must have been graduated from a college or university of recognized standing with major work in economics or statistics, and have had at least two years' experience since graduation in work dealing with the economic aspects of coal production, distribution, or marketing.

AMERICA'S COPPER INDUSTRY

Greatly Lowered European Consumption Since The War Cause Of The Unprecedented Depression In American Copper—As The Foreign Situation Is Cleared And European Nations Are Financially And Economically Restored Our Copper Industry Will Thrive And Prosper

By STEPHEN BIRCH*

THE American copper producing industry began with the opening of the Michigan copper mines about the middle of the nineteenth century, but it was not until 50 years later that production from the United States first exceeded that from all the rest of the world and America achieved its dominant position in the copper producing world, which it has since uninterruptedly held.

United States production increased from an insignificant total of 224,000 pounds in 1845 to the stupendous amount of 1,708,000,000 pounds in 1925. Total production from North and South America last year amounted to almost two and one-half billion pounds. This tremendous increase in production is, of course, the result of an equally great increase in consumptive demand. The copper industry has continued hand in hand through these three-quarters of a century with the improved facilities which industry and an increasingly exacting civilization have demanded; the telegraph and telephone, electric lighting, electric railways, automobiles, radios; in short, the history of America's copper industry is but the history of the progress of the refinements of civilization, which to us have now become necessities. In these America leads the world.

In 1925 the United States consumed practically twice as much copper as in 1913. This increase in consumption is due largely to two causes; first, of course, to the normal growth of the population of the country, which of necessity brings a normal increase in the demand for all commodities; second, the superiority and actual economy of copper and its alloys have become more commonly known and it has replaced inferior metals in many uses and become more widely used generally.

But America's copper industry can not really prosper with European consumption so far below what may be considered normal from all standards of the past. The copper industry has suffered as no other has suffered from the effects of the war. Like all other basic commodities, prices of copper were high and demand active during the war period. But, unlike any other basic commodity, copper has never recovered from the war's consequences. We all appreciate that the comparatively high prices prevailing during the four years prior to 1919 were because of the war, but we do not all realize that the low prices since the war are due to the same cause. Our greatest customer, Europe, staggering under a load of debt accumulated through dire necessity over a period of more than four years, has been unable to pay for anything but its bare needs. Its progress has been retarded and with it the progress of the copper industry.

Europe consumed only slightly more copper in 1925 than in 1913, but consumption per capita was considerably less, while per capita consumption here was approximately 70 percent greater. It is this greatly lowered European consumption which has been the cause of the unprecedented depression in our copper industry since the World War. That this cause is but of a temporary nature is clearly obvious. And as it is gradually corrected and Europe is restored, financially and economically, America's copper industry should once more thrive and prosper.

*President, Kennecott Copper Corporation.

A Large Copper Plant—The Miami Copper Company of Globe, Ariz.

COPPER MINING IN CALIFORNIA

High Cost Of Operation Prevents Developing New Producers At Present Copper Prices—Principal Producers Are In Plumas, Shasta And Calaveras Counties, Which Produced Approximately Fifty Million Pounds In 1925—Ranks High As Potential Producer

By C. A. LOGAN *

COPPER mining in California has occurred in three cycles, each of which has affected in general all the mines of the State, but each especially marked by the development of some particular district. The metal was known in the 50s in many counties of the State, but copper mining did not begin until 1860, when the discovery of the Napoleon mine in southwestern Calaveras County initiated the first commercial production.

During the period 1861-1869 the Napoleon, Union, Keystone, Empire, Campo Seco and smaller mines of Calaveras County were developed and produced ores containing from 12 to 25 percent copper. Only good grade ore could be handled because of the expense of marketing. Ore had to be taken by team, steamer and later by rail to San Francisco for trans-shipment to eastern refineries or to Swansea, Wales. But a few small reverberatory and blast furnaces were built in the State and were producing matte before the latter year. Other counties became productive, as visiting miners returned to their homes from the Calaveras mines and took up the search. Production was established in practically every county on the western slope of the Sierra Nevadas, from Tulare at the south to Plumas. Several of the coast counties shared in the activity, Del Norte, in the extreme northwestern end of the state, ranking second to Calaveras. The Union, Empire and Keystone mines of Calaveras County, now consolidated and producing under the Calaveras Copper Company, produced 125,739 tons of ore assaying 10 percent copper or better between 1861 and 1869. The price of copper fell to a point where the mines of this State could make little or no profit and most properties lay idle between 1869 and 1880. The mines of the Foothill Copper Belt had yielded their richest ores previous to this depression, but the great deposits of Shasta County had remained nearly untouched and their size was not realized by the few men who had prospected there.

The prominent gossan outcrops of the Shasta Copper Belt were not recognized for many years as the cappings of important copper deposits. The Iron Mountain Mine was located in the early '60s as an iron mine, and so held until 1879, when gold and silver were found in the gossan by James Sallee, who operated it for these metals. Its career as a copper mine began in 1895, marking the advent of the second cycle of copper mining. The early work at the Bully Hill and Ingot mines was also for gold and silver.

The region by this time had a railroad passing through the copper belt, limestone and quartz were available nearby for flux and blast furnaces were built, so that it was possible to treat at a profit the large but comparatively low grade ore bodies. Shasta County became the principal copper producer of the state. Between 1896 and 1925, inclusive, the mines produced 661,530,103 pounds of copper from a total of over 6,000,000 tons of ore. The principal producing properties were the Mammoth, Iron Mountain, Balaklala, Golinsky and Shasta King, on the west side, and the Bully Hill, Rising Star and Afterthought on the east. The collapse of the copper market at the end of the war, and the continued low price of copper, has resulted in the practical cessation of copper mining in that district. Production during the war was stimulated to the point where most accessible reserves of ore were exhausted. Remaining proved ore bodies are probably too low grade for exploitation under prevailing costs and at the present market price for the metal. The blast furnaces of the Mountain Copper Company at Keswick and of the Mammoth Copper Company at Kennett have been dismantled. Copper at present is produced in Shasta County, principally from the Rising Star Mine, at Bully Hill and the Afterthought Mine at Ingot, where the ores are worked chiefly for their zinc content. The Balaklala Mine is being reopened by the Mason Valley Mines Company as the type of ore found there is needed at their Thompson smelter.

The third and latest development of copper mines in California has been along the Plumas Copper Belt in Plumas County, where the Engels Group and the Walker Mine are the chief producers. Many smaller mines in the same section are idle at present. Engels and Superior Mines were developed by Engels Brothers over a period of many years, and became important producers in 1915. The ore from the consolidated groups was treated in the first oil flotation plant operated on a commercial scale in California, as the sole means of concentration. This plant has been enlarged several times and has an ultimate capacity of 1,500 tons a day. In recent years its output has been averaging over 1,000,000 pounds of copper a month, reaching 1,250,000 pounds monthly at times.

Walker Mine, operated by a subsidiary of Anaconda Copper Company, is 17 miles south of Engels. While the flotation plant here has less than half the capacity of that at Engels, the annual production does not lag far behind, amounting to 11,301,159 pounds for the year ended June 30, 1924. The copper output of the county, coming almost entirely from these two groups, amounted, in 1925, to 26,950,029 pounds. Besides the counties mentioned, where the bulk of our copper production has occurred, smaller and irregular production has been made from Trinity, Siskiyou, Placer, Inyo, San Bernardino and other counties. The Island Mountain Mine in southwestern Trinity County is the only present producer of any importance in this list.

GEOLOGY OF COPPER DEPOSITS

The mines differ considerably as regards geology and types of ore. In the workings of the Calaveras Copper Company (the old Keystone, Empire and Union mines) the ore is chalcopyrite with more or less pyrite and is deposited typically along seams in black Mariposa (Jurassic) slate, in the form of lenses with their long axes parallel to the dip and strike of the bedding planes of the slate. The main orebody is 600 feet long, averages 15 feet wide, dips 61 degrees northeast and strikes northwest. Serpentine lies on the footwall of the slate and amphibolite schist, or metadiabase, on the hanging wall. A granodiorite dike, said to carry up to 1½ percent copper, has been noted as an intrusive in the slate. The main orebody averages 4 percent copper, but at times rich bunches of chalcopyrite, carrying as much as 20 percent copper, are found. Smelter returns show no gold, and only one ounce of silver for each 980 pounds of copper. Present work is through a shaft 1,250 feet deep on the dip.

Other past producers in the same county, such as the Penn Mine and the Napoleon Mine, show lens-shaped orebodies in amphibolite or metadiabase,

* Mining Engineer, California State Mining Bureau.

with the ores carrying gold, silver and zinc as well as copper. The Calaveras Copper Company is the only operator not having gold or silver in their ore sufficient to aid them.

The Engels deposit in Plumas County was first described by H. W. Turner and A. F. Rogers as a magmatic segregation in norite-diorite, which was probably a differentiation product of the granodiorite batholith of the Sierra Nevadas. L. C. Graton and D. H. McLaughlin later expressed the opinion that the ore minerals were introduced after the rock had solidified and had suffered notable dynamic and structural changes. The Engels ore is generally low grade and disseminated; in the adjoining Superior Mine, owned by the same company, the ore is deposited largely along joint planes and is clearly secondary. The oxidized zone showed a leached rock, stained by malachite, limonite and chrysocolla. It was irregular in its lower limits, merging into chalcocite and carbonates. Below this the zone of sulphide enrichment was 25 feet thick, yielding chalcocite carrying 16 to 20 percent copper. Lower grade bornite ore appeared at a depth of 100 to 130 feet. Pyrite is absent or nearly so. The average length of the Engels orebody is 800 feet, average width 60 feet, with naturally no well defined walls. The average ore milled (the mixed product of the two mines) contains 2¼ percent copper, a little gold and silver. No. 10 tunnel, completed in 1925 at a cost of $400,000, has a depth of 1,262 feet. Engels total production to 1926 has been about 110,000,000 pounds of copper.

At the Walker Mine, second largest copper producer in the State, the vein is a strong, well defined quartz-filled fissure in hard diorite walls. On No. 3 level the vein was 20 feet wide, and on No. 4 level 45 feet wide, and the oreshoot was 900 feet long. A high grade streak five to six feet wide and 140 feet long on No. 4 level carried 15 to 17 percent copper. Chalcopyrite is most prominent, but bornite occurs, and pyrite is common. The gangue contains barite as well as quartz. The ore runs 3½ to 4 percent copper, 0.6 ounce silver and 0.1 ounce gold per ton. No. 8 tunnel, at an elevation of 6,200 feet above sea level, is the main working level, giving a depth of 800 feet.

In Shasta County's copper belt the orebodies occur in the Bully Hill and Balaklala rhyolites. The orebodies are roughly lens-shaped, occupying shear zones, and ranging from a few inches to 100 feet wide. Their age is thought to be Jurassic. The Mammoth orebody was 800 feet long and 200 feet deep, consisting of flat-lying lenses. It averaged 3 percent copper and $2 per ton in gold and silver, the principal minerals contained being pyrite, chalcopyrite and sphalerite. Another example is the immense pyrite deposit of the Mountain Copper Company's Hornet Mine, mined as a source of sulphuric acid and carrying only 0.7 percent copper.

At Bully Hill and Ingot the ores of the mines formerly worked entirely for copper have shown in later years an increasing amount of zinc. It is a complex, finely disseminated ore, carrying an average of 16 percent zinc and 3 percent copper, with 5½ ounces of silver and 0.03 ounce gold per ton, at the Afterthought Mine. In the Rising Star Mine at Winthrop the zinc content of ore reaches 22 percent. Both properties are being operated by California Zinc Company. Depths of 800 and 1,100 feet, respectively, have been reached.

Besides these developed and producing districts there are promising deposits in Siskiyou County, notably the Grey Eagle Mine, near Happy Camp, and the Blue Ledge Mine in Elliott Creek district, near the Oregon State line. Numerous gossan outcrops, showing copper, but only slightly prospected, occur throughout the western and northern parts of the county. The region of these mines has no railroad and the character of the country is such that mineral products and timber are the only probable sources of revenue for one.

Milling and Smelting; Present Status of Operations

California copper mines have been handicapped from early days by distance from smelters and markets. In the '60s ore was hauled by teams even from such remote districts as Alpine County, on the Nevada State line, across the Sierra Nevadas to Sacramento for shipment to the East or abroad by water. In Calaveras County mines are some distance from railroad. Smaller properties shipped ore, 10 percent ore being about as low grade as could be handled, though this varied with distance from railroad. Both the Penn Mine at Campo Seco (now idle) and the Calaveras Copper Company have operated blast and reverberatory furnaces. As they are outside the National Forests and not in a farm country they were not molested. The latter company has lately put a new reverberatory furnace in commission. Ore is concentrated by oil flotation, giving a product containing 18 percent copper, which is sintered in a Dwight & Lloyd sintering machine, smelted, and matte treated in converters and blister copper shipped to Tacoma. The blast furnace is kept to smelt ore containing 10 percent or more of copper. The flotation plant can handle 400 tons of 4 percent ore daily.

Agitation that arose in Shasta County forced the installation of bag houses at the smelters. The semi-pyritic process of smelting was used at Kennett, where the smelter capacity was 2,200 tons, the ore averaging 3 percent copper in recent years. No smelters are in commission in that county, the above one having been the last in operation, but now being in process of wrecking.

Numerous methods for the separation of copper and zinc have been tried upon the ores at Ingot and Bully Hill, where in late years zinc has become the principal metal. At present California Zinc Company is operating a bulk flotation plant at Winthrop, where ore from both the Afterthought and Rising Star mines is concentrated. The product carries 43 to 49 percent zinc, about 4 percent copper, 7 to 11 percent iron, 1.5 percent lead and 2.3 percent silica. It is shipped to Belgium for separation. During flotation treatment about one-half the pyrite is dropped by alkalizing the pulp.

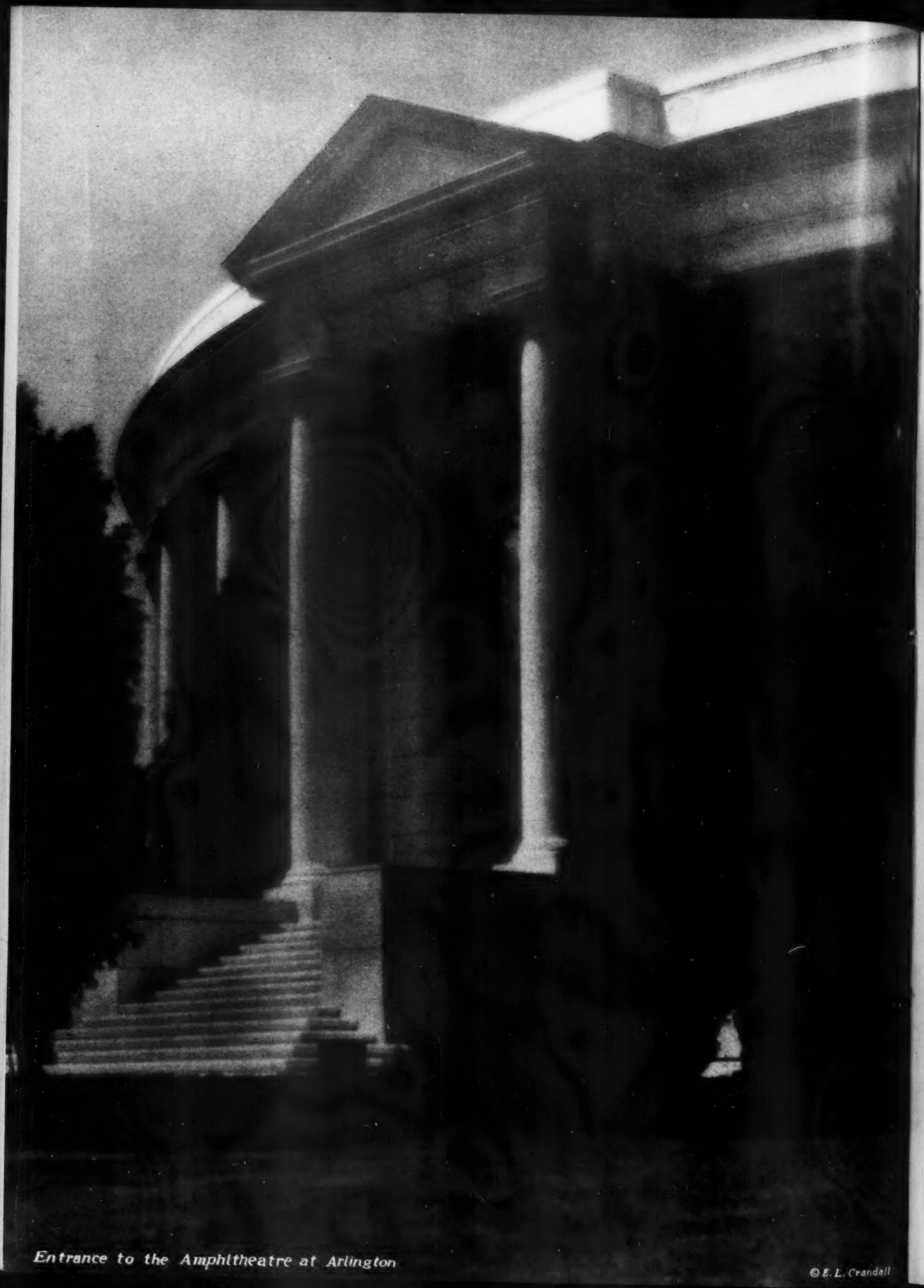
During the early years of development at Engels the mine was separated by 26 miles of rough mountain road from the nearest point on the Western Pacific Railway. A blast furnace was built in 1911, but was never used because of objections by the United States Forest Service. A minerals separation flotation plant was built in 1914 and has subsequently been enlarged to a working capacity of about 1,000 tons a day, with an ultimate capacity of 1,500 tons daily. The Indian Valley Railroad, 22 miles long, was built to the mine in 1916, being financed largely by the mining company. Concentrate carries 30 percent copper, 0.08 ounce gold and 8 to 10 ounces silver per ton. This mine is at an elevation of 5,263 feet in a well timbered country.

Concentrate from the Walker Mine's flotation plant is delivered over their aerial tramway, 9 miles long, to the Western Pacific Railway at Spring Garden for shipment to the Utah smelter.

Besides these plants, Mountain Copper Company maintains a smelter at Martinez, where they handle pyrite cinder for its copper content, after it has been treated for the manufacture of sulphuric acid. The ore comes from their Hornet Mine, in Shasta County.

Conclusion

California copper mines operate at comparatively high costs. There is consequently no incentive for developing new properties with present market prices for copper, although conditions do justify the maintenance and operation of such plants as are now in commission. The copper production of the State in 1925, according to the records of the Cali- (*Continued on page* 639)



Entrance to the Amphitheatre at Arlington

© E. L. Crandell

AMERICA'S SILVER INDUSTRY

Silver Producers Are Keenly Alive To The Possibilities For Increasing Production—Agreement With Silverware Manufacturers For Increased Use In The Arts Promises Interesting Results—Report of Indian Commission And Its Effect Upon Industry

By HAMILTON M. BRUSH*

ALTHOUGH silver is used and valued in every known part of the world, its production is primarily American in origin. According to the American Bureau of Metal Statistics, the production of silver in the United States, Canada, Mexico, and South America constitutes about 85 percent of the total world production. In turn, a very large percentage of the silver produced on this continent outside of the United States is owned or controlled by United States citizens. The United States in this respect occupies a position as to silver comparable to that of the British Empire as to gold. Any development, therefore, which affects the price or use of silver directly affects the United States. Whereas we have been able to build up a domestic demand for most of our principal commodities to an extent sufficient to make our domestic producers almost or quite independent of foreign consumption, silver is peculiar in that by far the principal consumption occurs outside of the United States and its possessions. Furthermore, the uses of silver are such that a low price is more apt to discourage than encourage consumption.

According to figures published by Messrs. Handy & Harman of New York, India and China have taken for the last two years over 60 percent of the current world's production of silver. The Orient seems to have taken over 75 percent for the first six months of 1926. Realizing the controlling percentage which the Orient takes, and also our relatively slight influence in this field, it is very easy to drift into an attitude of laissez faire; this the silver producers of the United States are not doing, and correctly so in my estimation.

Although the Oriental demand for silver is of more importance than all other uses combined, these other uses are important and serve to take a substantial percentage of each year's production and also serve to create a secondary demand during periods when the East is temporarily out of the market, thereby rendering a real service to silver. It is for this reason that the silver producers have agreed to join with the silverware manufacturers in an advertising campaign looking toward the increased use of silver in the arts. It is still too early to form an opinion as to whether this campaign will bear fruit, but we are all very hopeful.

Handy & Harman give as their estimate of the consumption of silver in the arts and industries of the United States for the years 1921 to 1925, inclusive, the following:

	Ounces
1921	18,000,000
1922	24,000,000
1923	29,000,000
1924	28,000,000
1925	31,000,000

Indications are that 1926 will exceed 1925. If this trend can be maintained, or possibly even slightly increased, it will be of real benefit to the silver producer, and that is the attempt that is being made.

Although we have not heard nearly so much in the recent past concerning the use of silver for subsidiary coinage purposes in Europe, I am convinced that this situation is developing in an encouraging way and as rapidly as possible under the present disorganized financial condition of such countries as France, Belgium, Italy and Poland. The Austrian and German Mints have been busy continuously in minting silver coins and have been in the market quite regularly for their supplies. Some of this coinage, in Austria particularly, is for other countries which use the Maria Theresa Dollar for their standard coin. It is this action on the part of Germany and Austria, and to a lesser extent on the part of Russia, which is encouraging.

You will remember that both Austria and Germany commenced the minting of silver coins at a time when money was scarce and their Governments almost bankrupt. It is my understanding, although I cannot state it as a fact, that the coinage of silver in Germany was undertaken by the German Government against the advice of the American experts on the Dawes Commission. I know it to be a fact that one of the American experts on this commission was very much opposed to the purchase of silver for coinage purposes, stating that, in his opinion, it was a wicked waste of money urgently required for other purposes. The German Government, however, interpreted correctly the mental attitude of their citizens. The Germans had become distrustful of their paper Marks and paper currency which depreciated in value almost from day to day; they had a mental picture of the old days when they were jingling silver Marks in their pockets and when these Marks remained constant in value from year to year. It was necessary to re-establish the confidence of the great mass of German people in their own currency, and what more direct method could be found than by again allowing them to carry the old silver coins of prewar standard fineness? As a matter of fact, the confidence was restored and the same expert who several years ago deplored the coinage of silver as a waste of money has since admitted that possibly the German Government was correct in its attitude and that the circulation of these coins had a very real part in helping to re-establish this confidence.

In view of the actual experience in Germany and Austria, it is a natural hope that when the financial position of France, Belgium and Italy becomes stabilized, these countries will decide to profit by the example of their neighbors and resume the use of silver in subsidiary coinage. It may be that Russia also will be included in this list, and, if so, it will have a tremendous influence on the future of silver.

The visible stocks of silver in the Far East are undoubtedly large. It is reported that stocks of silver in Shanghai were 120,000,000 ozs. as of July 1, 1926, as against 100,000,000 ozs. as of January 1, 1926, and 88,000,000 ozs. as of January 1, 1925. Probably these large stocks are more apparent than real as the disturbed conditions in China have, without doubt, forced the dispatch of a very considerable quantity of silver to the Shanghai banks for safekeeping. Although it is obviously impossible to make any definite statement of fact, because of the lack of Chinese statistics, it would not be surprising to find that the increase in the visible stocks in the vaults of the Shanghai banks was balanced by the decrease in the invisible stocks of the smaller interior banks and merchants.

The silver reserve in India reported in the currency returns amounted to approximately 307,000,000 ozs. on June 22, 1926, as compared with 286,000,000 ozs. on January 1, 1926, 277,000,000 ozs. on January 1, 1925, and 298,000,000 ozs. on January 1, 1924. Although these stocks would seem to be of ample proportions, you will note that there has been practically no increase in the amount since January 1, 1924. This would indicate that the up-country demand in India has during the last two and one-half years

* Vice-President and Manager, American Smelting and Refining Co.

fully absorbed the tremendous shipments of silver into India during that period.

Silver shipments to the Far East have compared as follows—in ounces. (Converting the reports in pounds sterling at 65c per ounce):

	First 6 Months 1925 Ounces	First 6 Months 1926 Ounces
New York to India.....	37,498,000	32,333,000
San Francisco to China..	16,646,000	26,881,000
London to India and China (approx.)	20,000,000	26,000,000
New York to China.....	644,000	8,147,000
Total	74,788,000	93,361,000

You will see, therefore, that shipments from these three principal ports to India and China for the first six months of 1926 were not only some twenty million ounces greater than for the same period of last year, but that at 93,000,000 ounces for the half year, shipments are going forward at the rate of 186,000,000 ounces per annum, or over 75 percent of the current estimated world production. This indicates that the Far East is, as usual, taking its full share currently of the new silver production of the world.

There has been considerable speculative buying and selling of silver in the recent past due to uncertainties as to the nature of the report to be issued by the Indian Currency Commission. This commission appointed by the Crown, because of an insistent demand on the part of Indian merchants and bankers for a gold standard, has completed its hearings both in India and England, and its report has been published within the last few days (August 3rd). Unfortunately at the time of writing it is impossible to refer to this report except in a most general and tentative manner as the official copy of the report has not yet been received in this country and the cabled reports, both private and to the Press, are contradictory in many ways.

It would seem from the cables received that the report is more unfavorable to silver than was generally believed would be the case, particularly if we look ahead 10 or 20 years. If the cabled reports are correct, the high spot in the report as it affects silver is the recommendation that beginning as soon as practicable paper currency notes shall be issued by a central bank and that these currency notes shall not be exchangeable for silver rupees as is now the case; that the notes shall be secured by gold and gold securities instead of by silver as at present and that a considerable part of the silver reserve stock now held against outstanding rupee notes shall be gradually disposed of over the next 10 years as the Indian public acquire confidence in the new notes. The old rupee silver coins are still to circulate and the old notes redeemable in silver are to continue to circulate for the present or until confidence is acquired in the new notes.

A cable just received from London states that the excess silver reserve for sale over the next 10 years, should everything work out according to plan, will be somewhere between two hundred and two hundred and fifty million ounces.

U. S. Bureau of Mines

Mill And Some Of The Shafts Of The Tonopah Mining Company, Tonopah, Nevada

Although I must repeat that any statements made at the present time must of necessity be tentative, I would call attention to a number of important factors for the encouragement of the American silver miner.

1. The English Government is commercially wise, and if they have silver to sell they will certainly not sell it on a weak or declining market, but will wait until such time as world conditions are favorable for silver and they can dispose of their excess stock at satisfactory prices.

2. The English Government knows the interest which the United States has in silver through our Treasury and Federal Reserve Bank officials and is not going to do anything willingly to create an unfriendly attitude on their part.

3. Silver has been flowing into India at the rate of tens of millions of ounces per annum for over half a century and in substantial amounts for hundreds of years before that. No one has any conception of the amount of silver now stored in India: It has been variously estimated all the way from three to six billion ounces.

The wealth of India is principally concentrated in land, cattle, gold, silver and precious stones, and not in industries or interest-bearing securities. Any action on the part of India, therefore, which would reduce the price of silver by say 10 or 20 percent would take a tremendous slice from the national wealth of India and would be much more harmful to the Indian people themselves than to any other people in the world. It is, therefore, almost inconceivable that India should take any action of such a nature as to automatically injure herself to such an extent.

4. The report is, no doubt, a carefully thought-out, sound financial scheme, but its success depends entirely upon the cooperation of the four hundred millions of native Indians. If they refuse to take paper rupees not convertible into silver and with an insufficient gold stock to allow them to get actual gold therefor, it is entirely possible that with their centuries of custom behind them they will still insist upon getting the actual silver rupee.

5. Pessimistic conclusions have been drawn from the fact that should this report be accepted, the Indian Government would not be in the market for silver for coinage purposes in the future, but we must remember that silver has taken pretty good care of itself for the last eight years, during which period the Indian Government has not bought a single ounce of silver for coinage purposes. All the tremendous takings of silver by India in the last eight years have gone up-country and not into official reserves; in other words, the silver has been made into trinkets, ornaments, or has more directly gone into hoarded stocks of either nobles or peasants.

The new or supplemental Pittman act, providing for the purchase of an additional 14,000,000 ounces of silver by the United States Government at $1.00 per ounce, was passed by the Senate at its last session, but was not passed by the House. There is considerable doubt as to whether this act will ever become a law. Although approximately $5,000,000, which represents the difference between the current market price and $1.00 per ounce on this quantity of silver, would be received with open arms by the silver miners of the United

States, the passage or non-passage of the act would have no real or lasting bearing on the silver market of the world. From a broad market viewpoint, therefore, the act is of itself unimportant. Naturally it affects the well-being of the silver miners, and its passage would remove from their minds the feeling that an injustice to them has been done.

There is little that can be said looking backward, and nothing that can be said with certainty looking forward concerning prices. The highest level reached in New York since 1922 was 73⅞c; the lowest level 62⅜c.

From 1926 up to the day when the report of the Indian Currency Commission was released, the range has been between a high of 68⅝c and a low of 63c. Since the report was published, the price declined on one day to 61⅝c per ounce, but immediately recovered to over 62c, where it now is (August 10). The deduction we would draw from this record is that silver has reached a new post-war level between 62c and 72c per ounce. Every time silver has approached 72c per ounce there has been a tremendous volume of selling sufficient to satisfy the demand; conversely every time silver has approached 62c per ounce there has been an equally insistent demand to support the price. As this situation has existed for about five years, the supposition is that after the violent fluctuations of the war years we have established a new silver price level around 67c per ounce. It will probably require some major disturbance to move silver out of this price range; whether the effect of the Indian Currency Commission's report is such a major disturbance it is still too early to tell.

INVESTIGATION OF CURRENCY AND FINANCIAL CONDITIONS

Meeting Of American Silver Producers' Association, In Conjunction With Annual Meeting Western Division The American Mining Congress, To Consider Plan Proposed By Senator Oddie To Investigate Conditions

CONSIDERATION is expected to be given by the American Silver Producers' Association at its meeting at Denver, September 20, of a proposal of Senator Tasker L. Oddie, of Nevada, chairman of the Senate Committee on Mines and Mining, and former chairman of the Senate Gold and Silver Commission, for an investigation of currency and financial conditions of the principal countries of the Orient and South America, either by a Senate commission or a subcommittee of the Banking and Currency Committee of the Senate.

Correspondence which has been exchanged between Senator Oddie and F. Y. Robertson, vice president of the United States Smelting, Refining and Mining Co. of New York, on the subject has been referred by Mr. Robertson to the directors of the Silver Association. The correspondence began with a letter from Mr. Robertson to Senator Oddie, in which he inclosed a letter written by him to the directors of the Silver Association relative to the action of the English Royal Currency Commission of London in establishing India upon a gold basis and the effect in India of the displacement by gold of its immense stocks of silver, which would be thrown upon the world's market in order that India might purchase her gold requirements. Mr. Robertson pointed out that during the past several years the importation of gold into India has been increasing. "If England desired to place India upon a gold basis, she could do so regardless of how it affected other countries, if it was decided that it was for her financial and commercial interests so to do," said Mr. Robertson. "But as England and the United States are so close together in their policies for the rehabilitation of the financial conditions of European countries, a remonstrance by the administration at Washington against any action that would tend to demonetize silver currency would be given proper weight." But Mr. Robertson further pointed out that the demonetization of silver would effect a very considerable loss upon mining communities, and he requested Senator Oddie to protest against demonetization of silver.

Senator Oddie advised Mr. Robertson that when the Senate Gold and Silver Commission was investigating foreign currency and exchange it noted the increasing importation of gold into India and anticipated that the strengthening of India's gold position might culminate in the present situation. Through failure of Congress to continue the life of the commission, Senator Oddie points out that there is at present but little information available concerning the currency and financial conditions in India, China, Japan, and countries in South America. Such information would, however, be of value in determining current currency policies.

Silver Consumption

"The work which was done by the commission in analyzing currency and financial conditions in European countries was of great assistance in expediting more normal conditions by the resumption of the gold standard in several countries and stabilizing the currency unit in others," says Senator Oddie. "While currency inflation compelled European countries to debase their silver coinage in order to maintain silver circulation, the more recently improved conditions resulting from deflation have in a number of countries made it possible to remint silver coins of a higher degree of fineness, which has resulted in the consumption of American silver. A movement is now under way which may greatly expedite the improvement of currency and financial conditions in France and Italy, which, if successful, should result in an increased use of silver for currency purposes.

Congressional Committee

"A Senate commission or a subcommittee of the Banking and Currency Committee of the Senate should be given authority to investigate the currency and financial conditions of the principal countries of the Orient and South America, so that reliable information could be made available to safeguard the monetary conditions of gold and silver throughout the world," concluded Senator Oddie.

Mr. Robertson was not inclined to look with much favor upon a further investigation of currency situations, saying:

"The information from such committees is usually very voluminous and full of uninteresting, but probably necessary data, and therefore is read and studied by only a few of the people who ought to be interested in the subject. If these reports could be condensed and concrete conclusions, facts, and figures be submitted, the general feeling of the public would be much more favorable to the various committees and their reports on important subjects. However, we are sending your letter to each director of the American Silver Producers' Association, and it will undoubtedly be considered at the coming session of the association, which is expected to be held in Denver, September 20."

THE OUTLOOK FOR DOMESTIC SILVER PRODUCTION

Problems Of Silver Industry Run Into International Finance and Economics—Political Action Big Factor—Present Downward Price Tendency A Temporary Disturbance As Importance Of Silver To The World Will Unquestionably Bring Conditions Back To Normal

By W. M. FERRY*

A DISCUSSION on the outlook for the domestic silver production necessarily involves a number of factors apparently outside of production itself.

The ramifications of this silver problem are extensive. They immediately run into International finance and economics. No one who gives the subject thought and study can fail to be impressed with the great difficulty of reaching worth-while conclusions.

In considering the phases of cost production and consumption of other commodities, the problem is simple as compared with a similar consideration respecting silver. Silver, while it is properly regarded as a commodity, is also very definitely a money metal. Civilized countries of the world are on a gold basis, it is true, but silver is recognized and used as subsidiary money throughout the world. Indeed, 700,000,000 people in the Orient know no other medium of exchange. This money attribute of silver makes it difficult to consider it in the same way as other commodities are considered.

Furthermore, the indestructible quality which attaches to silver as it does to gold and has made it so ideal for money purposes throughout the ages, brings into consideration another perplexing factor. It has been estimated that there are 10,000,000,000 ounces of silver in existence today. Where this vast horde is cannot be determined for certain. It is known, however, that the Oriental countries, particularly India and China, contain by far the largest part of this tremendous total. It is apparent that this fact has a governing influence on the price of silver. No one knows and no one can find out when or to what extent portions of this horde will leave its hiding place and come on to the general market.

Bearing in mind the foregoing observations, and furthermore, recognizing the factor of Oriental trading and exchange and the effect that these vital factors have upon world production as well as domestic production, it becomes apparent how difficult it is to reach definite conclusions respecting the domestic production of silver, which is the question the writer is asked to discuss.

The average world production of silver over a period of years is not far from 200,000,000 ounces per annum. Of this amount, the United States produces about 35 percent. This production, both world and domestic, comes generally from three sources, which may be divided approximately into straight siliceous silver ores, copper silver ores, and more or less complex lead zinc silver combinations, each class furnishing between 30 and 35 percent of the production.

In July, 1925, a formal hearing was had before the Commissioner of Internal Revenue at Washington for the purpose of showing cause why silver mines should not be revalued on a lower basis, the particular point involved being a proposed change in the price of silver as of March 1, 1913, from 65 cents to 57.8 cents.

W. M. Ferry

At this meeting about 65 producers were present. Much study and thought had been given by producers to the problem presented, with the result that the suggestions of some of the engineers in the Metal Valuation Division of the Internal Revenue Bureau were not adopted, the Commissioner being convinced by the producers' arguments that 65 cents per ounce was a reasonable price for valuation purposes to put upon silver.

In the work performed to sustain the contention of the producers, the most eminent authorities on mining, geology, and economics were consulted, and their unanimous opinion sustained the contention of the producers and doubtless strongly influenced the decision of the Commissioner of Internal Revenue.

Without attempting in this necessarily brief article to fully present the arguments and facts as brought out by these eminent authorities, it is nevertheless pertinent and proper to indicate in a general way the facts leading to their conclusions.

Prof. Edson S. Bastin, an eminent geologist whose experience comprehends the entire Western Hemisphere, and who has been a member of the council of the Geological Society of America and the vice-president of the Society of Economic Geologists, epitomizes the situation in a communication to the American Silver Producers Association just prior to the Washington Conference referred to heretofore. He said: "In my estimation every legitimate effort to stimulate production must be made if the world's increasing needs for silver are to be met. Frior to the outbreak of the world war the world's outlook for silver production was discouraging, in view of the difficulty in finding new mines, the exhaustion of the enriched upper portions of many silver deposits, and the waning production from the Cobalt District, and the exhaustion of old mine dumps treatable by cyanide process. During the war the world's needs vastly increased and present needs for monetary rehabilitation are large and of prime importance. New discoveries and developments have not kept pace with these needs and production from known mines must be maintained at high levels to meet situation."

The Eastman Kodak Company, representing a tremendous industrial use of silver; Dr. George F. Kunz, an expert on precious metals and member of many scientific and learned societies here and abroad, and a representative of one of the largest silver manufacturing industries in the world; Dr. Irving Fisher, well known economist, mathematician, and professor of political economy of Yale University; Professor Warren N. Persons, formerly professor of economics at Dartmouth and later of the Department of Business Administration and Banking of Colorado College, and now professor of economics at Harvard

* President of the American Silver Producers Association, Vice-President and Managing Director Silver King Coalition Mines Co., Salt Lake City, Utah.

University; Dr. Waldemar Lindgren, professor of geology and head of the Department of Mining and Geology at Massachusetts Institute of Technology; and Dr. L. C. Graton, professor of economic geology at Harvard, all agree with the convictions expressed in the quoted opinion above.

Silver cannot be produced at a profit which justifies the extinction of purely silver mines for much less than 75 cents an ounce. The same statement applies to other producing mines if the costs of production are charged to silver. In the copper and lead silver producing groups, however, the price of these baser metals strongly influences and perhaps governs the silver production. Nevertheless it is true that a lower price for silver automatically reduces production and has a tendency to stimulate consumption. This condition reacts and tends to equalize the situation by a gradual rise in price for silver and a gradual resumption of production.

It is true that political action respecting silver's use in coinage profoundly affects price and consequently production. Recent action of the British government in respect to India, as a notable case in point, has caused grave apprehension in the minds of silver miners as to the future price trend.

The long view of the situation, however, is apt to reach the conclusion that even this important governmental action will have but temporary influence. When it is realized that uncounted millions of people—common people if you please—know of no metallic money but silver and demand it for their use, a pessimistic outlook for silver is unthinkable.

Middle Europe must be supplied with silver for subsidiary coinage in order that the various monetary systems be rehabilitated, and industrial and political confidence be re-established in the minds of the people of these various countries.

Our country, which within its borders produces say 35 percent of the average world production, and whose citizens own or control perhaps 60 percent of the world's production, should be profoundly concerned that the great industry of silver production receive intelligent consideration in order that constructive steps be taken for its preservation and development.

The foregoing brief discussion will not be regarded as a logical argument on the question submitted, namely, the outlook for domestic silver production. Indeed, it only touches a few of the high spots in this complicated and interrelated question. However, a conclusion can be drawn that because geology knows of no great unexplored area which is likely to produce substantial amounts of silver; because of the rapid increase in the use of the white metal in trade and industry; because of the increase in population, the increase in per capita wealth, the rising standard of living and the notable increase in cultural development—because of these incontrovertible facts, domestic silver production should be maintained, and the price trend for the metal, in spite of an apparent present tendency downward, should increase substantially above the present market.

UNIVERSITY OF ARIZONA COURSE IN THE ADMINISTRATION OF MINERAL INDUSTRIES

The College of Mines and Engineering of the University of Arizona will offer during the academic year of 1926-27 a course in the administration of mineral industries, which contains a number of unique features and seems to offer well-qualified men an exceptional opportunity to equip themselves for relatively rapid advancement to administrative positions in mines, mills, and smelters.

Admission Requirements.—No one will be admitted to the course unless fully qualified in the following particulars:

1. He must have received at least a bachelor's degree in mining engineering or metallurgy from an institution of recognized standing.

2. He must have enjoyed several years of successful experience since graduation from college.

3. He must be selected and highly endorsed by his employers to enroll in the course.

4. He must sign a statement to the effect that if, after graduation from the course, he reenters the employment of the company for which he was working prior to taking the course he will accept a position at no higher rank and carrying no higher salary than the one he previously filled.

The cooperating companies hereafter listed agree to reemploy the men who gain leaves of absence to take the course. But such reemployment will be at no higher salary or rank than formerly received and held.

5. He must make application for admission to the course prior to August 15, giving the data outlined on a circular entitled "Information for Applicants," which may be obtained from the dean, College of Mines and Engineering (University of Arizona).

Nature of the Course.—The course will run through one college year of approximately nine months. It will comprise five months of formal study of economic subjects on the campus of the university, and four months of field work on the properties of different large mining or smelting companies in Arizona. The campus and field work will alternate, the first month being spent on the campus, the second in the field, the third on the campus, etc.

Number That Will Be Admitted to the Course.—It is tentatively proposed to limit the class to 12 men. If more than this number apply, it is probable that only the 12 men who appear to be best qualified will be admitted.

The Supervisor.—Dr. E. P. Mathewson has been selected to supervise this course. He is so well known among mining men, being generally recognized as the leading economic metallurgist in the country, that it seems hardly necessary to present his qualifications.

Cost of the Course.—It is estimated that the necessary expenses of a student who takes this course need not exceed $625 a year for a resident of Arizona, or $725 a year for a nonresident.

Cooperating Companies.—The following Arizona mining and smelting companies have agreed to permit students to study their operations in detail, and officials of these companies will give the students as much aid as they are able to render: Calumet and Arizona Mining Co. (?), Warren and Douglas; Copper Queen Branch, Phelps Dodge Corp., Bisbee and Douglas; Inspiration Consolidated Copper Co., Inspiration; International Smelting Co., Inspiration; Iron Cap Copper Co., Copper Hill; Miami Copper Co., Miami; Morenci Branch, Phelps Dodge Corp., Morenci; Old Dominion Co., Globe; Ray Consolidated Copper Co., Ray and Hayden; United Verde Copper Co., Jerome and Clarkdale; United Verde Extension Mining Co., Jerome and Clemenceau.

Dates of Beginning and Completing the Course.—Students must register on September 13 or 14, and the commencement exercises will be held on Wednesday, June 1.

Degrees.—Upon the satisfactory completion of the course, the degrees of engineer of mines (E. M.) or of metallurgical engineer (E. Met.) will be conferred upon the members of the class. It is possible that the new degrees, master of mining administration (M. Min. Ad.) or master of metallurgical administration (M. Met. Ad.), will be created and conferred upon such members of the class as prefer them to the professional degrees mentioned.

Continuance in the Course.—This course is designed only for men who are seriously in earnest in their desire to avail themselves of an unusual opportunity to equip themselves for administrative work. Only men who work hard and faithfully and can show a satisfactory degree of accomplishment will be able to graduate. The university authorities reserve the right at any time to dismiss from this course any student whose attitude is in any way unsatisfactory.

For further information, application blanks, etc., address the dean, College of Mines and Engineering, University of Arizona, Tucson, Ariz.

INCEPTION AND DEVELOPMENT OF HYDRAULIC MINING IN CALIFORNIA

Hydraulic Mining First Became Possible In 1853, And Thrived Lustily Until Difficulties Arose Concerning Disposition Of Tailings—Since That Time This Form Of Mining In California Has Practically Been At A Standstill, In Spite Of Repeated Efforts To Rehabilitate The Industry

By JAMES D. STEWART*

ON the 19th day of January, 1848, James W. Marshall, who was employed by Captain John A. Sutter to build a sawmill on the American River at Coloma, near Sacramento, now the capital of the state, discovered several small gold nuggets in the millrace while sluicing the earth and gravel away. Neither Sutter nor Marshall had any knowledge of gold mining, nor had any of their employees. For some time they recovered particles of gold by picking the gravel down into the millrace and rushing a quantity of water through it, the water was then shut off and they picked up the pieces of gold that had lodged in the crevices of the rock.

They were thus engaged when one Baptiste, a Frenchman who had mined in Mexico, heard of the gold strike and came to investigate. He first made a wooden batea or gold pan and prospected the gravel, then he built a rocker and went to work in earnest to recover the gold. Sutter's employees watched him with awe and then followed suit. Later came the long tom and then the sluice, devices which increased production greatly. In 1848 California's gold production was $245,301, in 1849 over $10,000,000, in 1850 over $41,000,000, in 1851 $75,000,000 and in 1852 over $81,000,000.

As the beds of the streams, nature's sluice boxes, were cleaned of their gold, the miners began to trace the enrichment to its source and discovered the dead river channels of the Tertiary, Neocene and other past ages high up on the mountain sides. Some of these channels were covered with a great overburden of lava while others were free from any capping. The latter were attacked by running streams of water over the top of the deposit and loosening it with picks and bars, then washing it through sluices to recover the gold. The water essential to this operation was secured through ditches dug from adjacent rivers and canyons. The first ditch constructed in California to convey water from a stream to a mine was dug at Yankee Jim's in Placer County.

About this time the ingenuity of the miners was being taxed to find ways and means of working the great beds of low grade gravels. At Yankee Jim's in 1852, Col. William McClure conveyed water through a flume built on a trestle and set on a steep grade. The water ran through this flume with great velocity and was directed against the bank of gravel and greatly facilitated its disintegration. Later in the year one Chabot, a Frenchman, at Buckeye Hill near Nevada City in Nevada County, set up a rig after the pattern of McClure's, adding a cover to the flume and fastening it down with iron clamps. He attached a hose to the end of it and was able to shift the water at will.

This article is one of a series of three which Mr. Stewart has prepared for the Mining Congress Journal. The other two articles will appear in the October and November issues. These articles will deal with first, the inception and development of hydraulic mining; second, the conflict that caused its cessation, and, third, the benefits that will accrue from its rehabilitation.

Hydraulic Mining At Gold Run, Placer County, Calif., 1872

However, it remained for a Connecticut Yankee, E. E. Matteson, to put the finishing touches on this contrivance. After watching Chabot's rig he copied the plant at his mine at American Hill near Nevada City, and added a nozzle to the hose. Thus in 1853 hydraulic mining had its birth—the greatest earth moving device ever conceived by man.

A word regarding the type of men who brought this invention into existence might not be amiss here. The men who came to California in the fifties were those who had been frugal enough to have saved the wherewithal or who had the integrity to borrow the funds necessary for the trip. Then they must have had the physical stamina to survive the hardships of the journey. The writer of early day history is prone to dwell upon the gambling, shooting, prostitution, dance-hall hell raising phase of the early settlement of California, but in Placer County alone before 1861, the miners had dug 547 miles of major canals and 915 miles of minor ditches to get water to their mines, had run 186,990 linear feet of tunnels, constructed roads and trails to get supplies to their claims, built towns and performed all the necessary duties of carving a civilization out of a wilderness. This was done in one small county and surely in the face of such achievement only a small percentage of these pioneers could have engaged in the deviltry that muckrakers love to write about.

Like a giant unleashed, hydraulic mining grew by leaps and bounds in the hands of these industrious men. Great canals were constructed and the canvas hose soon gave way to riveted sheet iron pipes. The first nozzles used were simple devices patterned after the nozzle of a fire hose. With pipe lines increasing in size to 12 and 20 inches, and larger, in diameter and under heads up to 200 pounds pressure per square inch, and greater, the need for different methods of discharge was met by the invention of the Monitor, Giant, Dictator, etc., all efficient means of discharging water against the bank of gravel.

* Mining Engineer, Auburn, Calif.

Malakoff Diggings In The Old North Bloomfield Hydraulic Mine, Nevada County, Calif.

The gold saving devices grew from small sluice boxes paved with slim pine poles to great sluice flumes, three, four and even eight feet in width. These flumes were paved with rock, or pine blocks 12 inches thick and set on end. In later years railroad rails were used for paving. Attached to these flumes were undercurrents for saving the fine gold. This device was invented in San Juan in Nevada County. The undercurrent consisted of a grizzly set at the end of the flume, flush with the paving. The bars usually had three-quarter inch spaces. The sand and small gravel and a small quantity of water dropped through the grizzly into a sluice box which conveyed it to the undercurrent. The undercurrent itself was a sluice box, twelve feet or greater in width and 50 to 100 feet in length, paved with 2" x 4" scantlings set on edge one inch apart. The sluice flume usually had a gradient of one-half to one inch per foot and the undercurrent slightly greater. The undercurrent proved an efficient saver of fine gold and many mines would not pay without them.

Often to tap a gravel channel at a proper depth to obtain grade for the sluice flumes, great tunnels were run through the rim rock. The tunnel was run through the rock to the center of the channel and a shaft upraised to the gravel and then on through to the surface. Water was turned down the shaft and its sides gradually caved and sloped from the top until a pit of sufficient size was opened to permit of the hydraulic giant being set and actual operations commenced. Needless to say great skill was required to open a hydraulic mine in this manner.

Failures were few in this class of mining. J. Ross Browne in his report to the Secretary of the United States Treasury in 1868 states of the Gold Run Mining District in Placer County, "Nine thousand miners inches (a miners inch equals one and one-half cubic feet per minute) of water are used here requiring the payment of $1,000 a day or more in gold." And this was but one of many districts pouring its wealth into the channels of trade. Four-fifths of all the gold produced in California came from its gravels and hydraulic mining produced the major portion of the gold obtained from gravels. Prior to the Civil War, California's mines produced approximately $600,000,000 of gold and during that conflict, about $200,000,000. This was made possible largely by hydraulic mining and played no small part in saving this Nation from division.

However, at the time hydraulic mining was the uncrowned king of wealth production in California, another giant was awakening that was to lay it low. Along the Sacramento River lies a body of land which probably has no rival on this globe for fertility, desirability and productiveness. As the hydraulic miners and others demanded food stuffs in ever increasing quantities, farmers tilled these lands and became wealthy supplying these needs.

As their lands were frequently visited by disastrous floods, the farmers began to seek the cause and found that the beds of the rivers were being raised from year to year by the debris from the mines. The hydraulic miner received the blame for this state of affairs and after several years of bitter recrimination the breach widened into open conflict which was to end the world's most spectacular and profitable form of mining. This phase of hydraulic mining will be treated in the next article of this series.

INDIAN CURRENCY COMMISSION RECOMMENDS GOLD BULLION STANDARD

THE report of the Indian Currency Commission which has just been made public, makes recommendations as follows, according to a cable to the Department of Commerce from Assistant Trade Commissioner Sabine, Bombay: First, the establishment of an absolute gold bullion standard, effective 1931; gold not to circulate as money, and sovereigns not to be legal tender; the present currency note and rupee circulation to remain and be convertible into standard gold bars; second, the creation of a new central reserve banking institution to become operative not later than January, 1929; third, that the rupee be stabilized in relation with gold at 18 pence; fourth, that the reserve bank be legally obligated to buy and sell gold at gold points, not later than January, 1931, and that during the transition period the government be legally obligated to perform this function.

The government approves at once the recommendation regarding exchange and views the other items favorably it is reported. It proposes to present to the next legislature, which convenes in September, items three and four and meantime will maintain exchange between three-sixteenths of a penny above, and one-quarter below, 18 pence to the rupee.

COPPER IN CALIFORNIA

(*Continued from page* 632)

fornia State Mining Bureau, was mostly from three counties, whose principal active mines have been mentioned above, namely: Plumas County, 26,950,029 pounds; Shasta County, 14,565,967 pounds, and Calaveras County, 4,906,650 pounds. Production in Plumas County is increasing, and this district promises to continue as the largest producer for some time. The extent of the Plumas copper belt has not been outlined. The two principal mines are 17 miles apart, with many copper prospects but no real development between them. Shasta County has unexplored areas possibly containing future mines. Siskiyou County has two developed mines and numerous prospects, all too far from present railroads to be operated at the present price of copper. The mining regions of this county are all within the National Forests, where blast furnaces would not be permitted. A railroad is needed to open these mines.

Space does not permit mentioning the numerous other copper possibilities of the State, but there is a great number of small mines, only superficially developed, that can produce copper whenever the price may warrant.

THE OUTLOOK FOR THE DOMESTIC ZINC INDUSTRY

Zinc Sales In Form Of Ore, Slab, Rolled, Pigments And Salts Approximated A Quarter Of A Billion Dollars In 1925—The Record For First Six Months Of 1926 Leads To The Belief That Both The Dollar And Tonnage Volume Of The Industry Will Exceed That Of Last Year

By STEPHEN S. TUTHILL*

ZINC and Its Corrosion Resistance"† recites that an interesting peculiarity of zinc is that it was widely used industrially *before* it was discovered.

Until recent years zinc has been handicapped by nicknames. The milled ore (zinc concentrates) has been called "jack" and other names and the metal (slab zinc) has been known as "spelter," and earlier as "calaem," "tutaneg" and "spiauter." These names have been as mystifying to the American buying public as the metal itself was to the Hindus who extracted it from Calamine as early as 750 A. D. under the impression that it was a peculiar form of tin. Slab zinc has also been known as "false silver."

But now zinc is known as zinc, and there is no more reason why it should not be known as zinc than that copper should not be known as copper and tin as tin.

Zinc ores are generally distributed throughout the world, but owing to our higher industrial development the United States produces and consumes a larger tonnage of zinc than any other country in the world.

Zinc concentrates are produced in the Adirondack Mountains (New York); in Northern New Jersey, Eastern Tennessee and Southern Wisconsin; in the Tri-State District, at the junction of the States of Missouri, Kansas and Oklahoma; and in many of the Western States.

In 1925 the Tri-State District outputted one-third of the zinc concentrates used in the world, with a selling value of forty-five million dollars.

In the first six months of this year over 60 percent of the zinc concentrates converted into slab zinc in this country came from the Tri-State District.

Our ability to produce zinc concentrates is such that during 1925 over 40,000 tons of zinc concentrates were exported from the Tri-State District, and between 20,000 and 25,000 tons from other sections, to those countries formerly supplied to a large extent from the Broken Hill District of Australia. These latter deposits, however, are now under conservation by the British Government. At this writing the export of zinc concentrates has practically ceased, because of the British strike diverting some of Great Britain's Australian ores to the Continent.

During the past five years there have been marked strides made toward perfecting the processes of extracting zinc and lead concentrates in the Tri-State District. In passing, it may be well to explain that one-sixth of the production of the Tri-State District is in the form of lead concentrates.

An authority estimates that improvements in such extraction, conducted largely in cooperation with the Bureau of Mines, has resulted in a 15 percent increase in recoveries and an annual saving of $5,000,000 to the miners of zinc and lead in the Tri-State District.

Zinc was first commercially smelted in Europe in 1740, but not in the United States until 1860.

The zinc smelters of this country are credited with a production of 320,000 tons of slab zinc in the first six months of this year. This is a 10 percent increase over 1925.

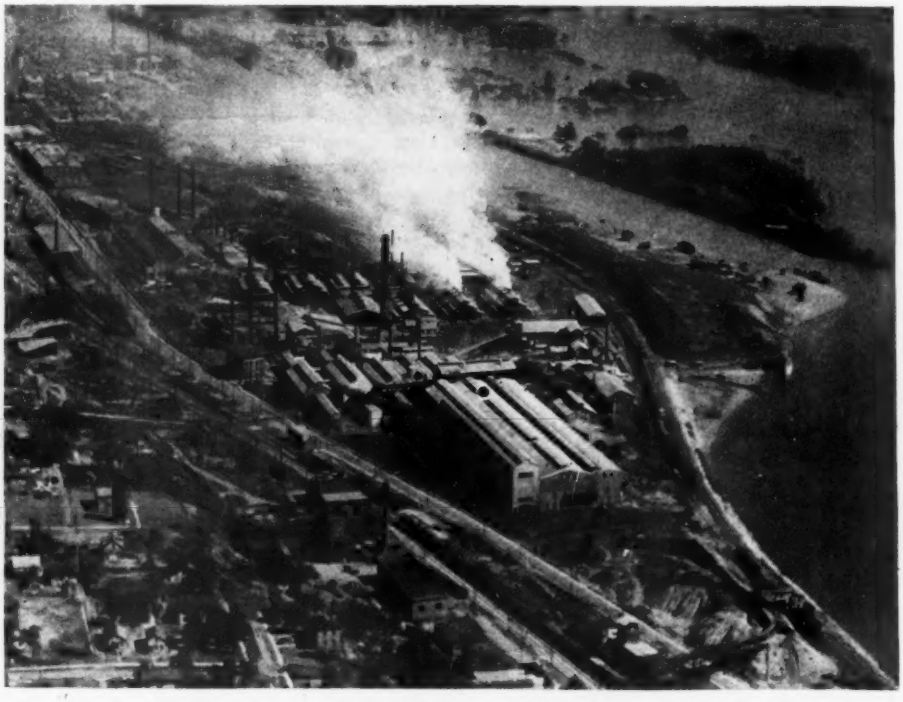
Gauged by monthly shipments averaging fifty thousand tons, less than two weeks' stocks of slab zinc were in the hands of the smelters on July 1. More than one-half of the slab zinc produced in this country in 1925 was outputted in states adjoining the State of Missouri.

The smelters of zinc, like the miners of zinc, are constantly striving for improvements in recoveries, and no small advance has been made in recent years in prolonging the life of the retorts in which approximately 86 percent of the United States slab zinc is produced.

In 1925 over 65,000 tons of slab zinc were shipped from smelting plants for export, but the 1926 exports have so far been seriously affected by the British strike and Continental offerings of slab zinc which under normal conditions would be absorbed in the countries of origin.

One-half of our domestic slab zinc was used in 1925 for galvanizing (zinc coating) purposes; one-half of this zinc coated material was in the form of sheets for roofing and siding.

During the past two years



Plant Of The Illinois Zinc Company, Peru, Ill. Smelters, Rolling Mills And Coal Mines. Zinc Mines Are At Joplin, Mo.

* Secretary, American Zinc Institute, Inc.

† Publication of American Zinc Institute, now in preparation.

Zinc Plant, Boska Mining Company, Miami, Okla.

considerable progress has been made in improving and increasing the sale of galvanized (zinc coated) material through the efforts of the producers of steel and of zinc. This is reflected in last year's 20 percent increase in the use of zinc for the coating of iron and steel.

A recent test at the Bureau of Standards definitely established the fireproofness of the zinc-coated steel garage, and it is expected that the results of this test will be a marked increase in the sale of the galvanized (zinc coated) material for such purposes.

"Galvanized" (zinc coated) material was first commercially produced in 1836.

Today there are four processes of zinc coating, namely, hot, cold, dry, and wet.

First, the hot process, which consists of applying zinc by dipping iron or steel sheets, wire netting, tubes, etc., into a bath of molten zinc.

Second, the cold process, which consists of coating small wire netting, screws, bolts, etc., with zinc in an electrolytic bath. This process is generally known as electro-galvanizing and has been in use about 20 years.

Third, the dry process, or Sherardizing. This process, which was used in prehistoric times, is named in honor of Sherard Cowper-Cowles, in whose London laboratory it was rediscovered in 1902. The articles to be thus coated, such as bolts, screws, nails, chains and stampings, are heated in the atmosphere of zinc. This is produced by placing zinc dust in the furnace with the articles to be coated.

Fourth, the wet process, otherwise known as the Schoop process, by which, under comparatively recent patents, zinc is melted in and discharged from a spray gun or pistol directly onto the articles to be protected; for example, iron and steel tanks, bridges, girders, machinery, rolling stock, etc.

In addition, there is now actively functioning a Sectional Committee on Specifications for the zinc coating of iron and steel under the procedure of the American Engineering Standards Committee and the sponsorship of the American Society for Testing Materials. This Sectional Committee is composed of 50 of the leading producers and consumers of galvanized (zinc coated) products in all forms, and its technical committees, the scope of whose work ranges from tacks to the hulls of high-speed vessels, are making steady progress in the framing of national standards for the union of steel and zinc in its many forms. The importance of the work of this Sectional Committee to the steel and zinc industries and to the consumers of their products in combination is self-evident.

The annual wastage of iron and steel through corrosion having been estimated at $3,000,000,000—including the relatively large quantities of coal required in the production of the wasted iron and steel—many experiments are now under way with a view of conserving our resources and expanding our activities in the industrial field in this direction. These include the electroplating of iron and steel with chromium and the production of irons of exceptional purity and of copper-bearing and stainless steels.

As this question of the prevention of corrosion is, of course, an economic one, the zinc producers view the situation at present with equanimity, for the reason that zinc is not only electronegative to iron and steel, but it also enjoys a relatively low cost, it can easily be applied to iron and steel in several ways, as previously stated, and it can be readily soldered.

Twenty-eight percent of the slab zinc production of 1925 was used in the field of alloys (brass-making, etc.). As Dr. Gillett, of the Bureau of Standards, says in "Chemistry in Industry," Vol. I, page 194: Some of the alloys are very different from the metals that enter into them. Copper is red and quite soft and weak. Zinc is whitish, weak, and rather brittle. By melting together, i. e., alloying, two parts of copper and one part of zinc we get brass, which is yellow, strong, much harder than copper, and much less brittle than zinc.

One-half of the 1,600 listed alloys contain zinc. With the exception of 67 zinc base alloys zinc loses its identity in its union with other metals. This is unfortunate, but probably impossible of correction at this late day.

The alloy of the largest number of finished units is the 1-cent piece. According to the Director of the Mint, more than $188,000,000 in 1-cent pieces were minted in 1925. This coin contains 95 percent copper, 1 percent tin, and 4 percent zinc.

Until two Englishmen discovered in the early part of the last century that zinc could be made malleable by heating it to a certain temperature, the use of zinc was principally in the fields of medicine and brass-making. So heated slab zinc may be rolled and/or worked into sheets, strips, plates, rods and tubes, and finished to retain its natural color.

More than a century ago European builders realized the value of sheet or strip zinc in weather-exposed construction, especially roofing. Today a very large percentage of the total output of European slab zinc is so used. Many roofs covered when zinc was first used exist today in good condition.

Tests on zinc exposed to the weather have shown that, under ordinary weather conditions, it would take 400 years to decompose a sheet 0.029 inch thick and 723 years for a piece 0.053 inch thick to disappear.

The domestic manufacturers of rolled zinc are constantly working to overcome the American tendency to use low-priced roofing materials without considering the ultimate cost. Owing to these efforts on the part of the manufacturers the tonnage of rolled zinc in the form of shingle, standing seam and corrugated

roofs, as well as corrugated siding, and roof eaves, troughs, downspouts, ridge caps, valleys and flashings have shown a marked increase.

In fact, while only 12 percent of the slab zinc produced in the United States last year was rolled, yet the tonnage produced in 1925 exceeded 1924 by 17 percent and 1923 by 28 percent. The growth in this branch of the zinc industry has not been due altogether to its growing popularity for roofing and its accessories, but also to the increase of its use in the automobile and radio industries. It is estimated that 30,000 tons of slab and rolled zinc were used by the automobile industry in 1925.

Since the popularizing of the radio, it is estimated that the production of dry cell batteries (the containers of which are made of rolled zinc) exceeds 200,000,000 annually.

Plate zinc is suspended in boilers to prevent the corrosion of the boiler tubes.

The use of zinc in the form of sheets and plates is rapidly being extended by engravers and lithographers.

The remaining 10 percent of slab zinc is used in the manufacture of French oxide, lithopone, atomized zinc dust and castings, and for the desilverization of lead.

In 1925 the tonnage of zinc pigments and salts in the form of zinc oxide, lithopone, zinc chloride and zinc sulphate increased 20 percent over 1924.

The word "zinc" dates from the fifteenth century and was first used by the Swiss medical philosopher, Paracelsus, who had much to do with the application of chemistry to pharmacy and therapeutics.

An examination of the United States Pharmacopoeia will show how extensive has become the use of zinc in the field of modern medicine.

Zinc is one of the most pervasive of the metals.

Briefly, to illustrate how intimately we associate with zinc from day to day: The house in which you live is probably painted inside and outside with a zinc base paint, and may be roofed, guttered, and spouted with rolled zinc. The brass bed in which you sleep and the other items of brass in your home are one-third zinc. The fixed and movable metal equipments of your kitchen and dining room contain zinc, as do the linoleum or oilcloth on your floors and the shades on your windows. Your automobile contains at least 4 percent of zinc in metallic form and zinc oxide is probably the compound used to increase the strength and toughness of your rubber tires.

The late war could probably not have been won without zinc—slab zinc was used largely in the manufacture of munitions and for other military purposes.

The smoke screens of the ships were a product of zinc dust, and a zinc paste was used as a protection against mustard gas burns.

Scientists tell us that zinc is to be found in the sun and in animal, plant and sea-born life, and that it is necessary to the proper functioning of the human body. Zinc is with us from the cradle to the grave. The base of the powder with which the new-born babe is dusted is zinc and the modern sanitary burial casket is zinc-lined or of solid zinc.

Zinc, in truth, enters into virtually every activity of life.

The blight of overproduction, which is the bane of fair profit in modern business, is gradually being overcome in the zinc industry through a more intelligent analysis of its statistics.

It is the general opinion within the industry that the outlook for the domestic zinc industry is promising.

STATES' SHARES OF MINERAL LEASING RECEIPTS

PAYMENTS to State Governments of their share of receipts from bonuses, royalties, and rentals from oil, gas, coal, and other mineral leases on public lands for the fiscal year ending June 30, 1926, amounted to $3,173,851.27, representing 37½ percent of receipts from leases on public lands within their borders in accordance with the terms of the General Leasing Law.

The largest amount was paid to the State Government of Wyoming, its share of the receipts being $2,585,698.59. California was second, receiving $433,475.44, while Montana was third with receipts amounting to $98,482.97. The following is a tabulation of the payments to States covering their receipts under the General Leasing Law for the past fiscal year:

Alabama	$345.00
California	433,475.44
Colorado	31,531.94
Idaho	370.36
Louisiana	350.06
Montana	98,482.97
Nevada	561.43
New Mexico	6,539.01
North Dakota	3,457.36
South Dakota	90.06
Utah	12,311.93
Washington	637.12
Wyoming	2,585,698.59

Receipts for the fiscal year of 1926 from mineral leasing paid to the State Governments were $283,056.80 less than the previous year.

NEW METHOD OF BURNING LIME PREVENTS WASTE

AN outstanding problem in the lime industry is the profitable utilization of the small stone, known as spalls and fines. Stone under four inches in size cannot be calcined successfully in the shaft kiln, and every day thousands of tons of such stone are either entirely wasted or are sold at prices so low as scarcely to cover the cost of production. Lime is an essential commodity in the chemical, agricultural, and building industries. Lime is produced at over 400 plants distributed throughout almost every state in the Union, and the annual production value is approximately $40,000,000. Any improvement in quarrying or operation processes which will eliminate waste is, therefore, of real economic importance.

The Bureau of Mines through the Nonmetallic Minerals Station at New Brunswick, N. J., has given much study to possible solutions for this waste problem. It has been found that fines are successfully calcined in the rotary kiln, and that rotary kilns are gradually being brought to a higher point of efficiency, but that rotary kilns present certain serious disadvantages. Having in view the development of equipment less costly, less cumbersome, easier to manipulate and of higher fuel efficiency than the rotary kiln, exhaustive experiments have been made with a sintering machine such as is used for roasting sulphide ores.

The sintering machine consists essentially of a series of traveling pallets with perforated floors. The pallets loaded with crushed limestone pass beneath a burner which supplies an intense heat, and over a suction box which maintains a downward draft to carry the flame through the charge. Complete calcination is attained in 30 to 60 minutes. Small scale tests were followed by more complete tests on a small-size standard commercial machine. A general average of all tests made gave a fuel ratio of 5.5 pounds of lime per pound of kerosene plus 5 percent of coal which was mixed with the charge. This compares favorably with present commercial practice. Several important changes may be found necessary before the highest point of efficiency is attained.

The advantages claimed for the sintering machine are low first cost, low maintenance cost, fair fuel ratio, continuous operation, and ability to use small stone. The results of the investigation indicate that the machine has excellent possibilities for the production of lime from small stone, but considerable redesigning is necessary to adapt it to this use. A detailed description of the machine, the changes made in its construction, and the experiments conducted with it are given in Serial 2762, entitled "Manufacture of lime from small stone with a sintering machine," a copy of which may be obtained on request from the Bureau of Mines, Department of Commerce, Washington, D. C.

ZINC IN AMERICAN INDUSTRY

Zinc Plays Prominent Role In American Industry, And In Its Various Forms Is Used In A Surprising Number Of Industries—The Rapid Progress Of Industry And Changes Which Scientific Research Dictate Prevent Safe Prophecy As To Increased Uses Of Zinc

By A. P. COBB*

Photographs by Underwood & Underwood

THE American public lacks Zinc Consciousness. Although the use of zinc has become universal and its field of application is extending daily, its loss of identity through combination with other materials is responsible for the failure of "Zinc" to become a familiar lay word. The manufactured products infrequently suggest their components, or indicate in any way the metal which is at the base of the operation. Even those engaged in an industry using zinc in one form do not realize, or seldom, if ever, stop to consider the many other forms in which they unknowingly use zinc.

In its various forms zinc is used in so many industries entirely unrelated to each other that a quick glance into the different industries may be enlightening. Alloyed with copper, in varying proportions, it forms the valuable compounds, brass and bronze, while its combinations with other metals find various uses in the arts. Iron dipped into the molten metal becomes coated with it (galvanized) and is thereby protected against oxidizing agents. Rolled into sheets it is employed in architecture for roofs of buildings, water tanks, conduits, etc. The oxide of zinc, produced either from the metal or directly from the ore forms a white pigment which is extensively employed in the manufacture of paints and by the rubber trade for admixture with the crude rubber in the preparation of many articles. Lithopone, a zinc-barium pigment of comparatively recent rise to prominence, is also largely used by the paint and rubber trades. Most of the zinc produced is used in these ways, but considerable quantities are consumed in galvanic batteries; in photo-engraving; in plates hung in boilers to prevent the formation of scale; for desilverizing lead bullion; for precipitating gold in the cyanide process; in the form of powder (known variously as zinc gray, zinc dust and blue powder) as a reducing agent in organic chemistry and as a paint for iron; and in the preparation of numerous salts of which the most important are the chloride, employed as a preservative for wood; and the sulphate, employed in the manufacture of lithopone, in medicine, in dyeing and in the manufacture of glue.

By far the largest consumption of zinc in industry is in the form of slabs commonly known in the trade as Spelter. One of the first acts of the American Zinc Institute after its formation was to urge that, as the name slab zinc more clearly identified the product than the name Spelter the nomenclature should be changed. The metal is now referred to as slab zinc in all trade paper quotations and in publications of Government bureaus. The history of the production of slab zinc in the United States may be naturally divided into two periods, one of experimentation prior to 1860 and one of commercial production from 1860 to the present. Experiments were carried on before 1860 near all the zinc producing centers of the country that have since become prominent. Zinc was so little known, however, that a Dr. Anderson, who was experimenting at Potosi, Mo., was suspected by his neighbors, witnessing the secrecy of his operations and seeing small bits of white metal scattered about the place, of being engaged in counterfeiting silver money. The outbreak of the Civil War eliminated temporarily whatever scattered market there may have been for slab zinc, but in 1862 or 1863 a lively demand arose for zinc for use in the manufacture of arms and cartridges. During the cessation of manufacture in the early stages of the war experiments had been made, so that when manufacturing was begun again it was with decidedly improved methods. Production in the United States in 1864 was about 1,800 net tons, which rose to 33,000 in 1882, and over 669,000 tons in the peak production years of the World War, when the Allies purchased their needs largely from America. The annual production is now running at the rate of about 600,000 tons.

Since the Civil War the manufacture of brass, which uses approximately 30 percent of the slab zinc consumed in the country, has shown a steady and rapid increase until it has become one of the country's leading industries. Brass is employed chiefly in the form of castings, sheets, wire and tubes. The uses of cast brass are so manifold and familiar that it would be futile to enumerate all of them. The manufacture of electrical apparatus is a highly important channel of consumption. Large quantities of cast brass are employed in naval construction. Gas fittings and plumbers' supplies, and many small articles required in architecture and building call in the aggregate for a large supply of brass. Sheet brass is employed for the manufacture of plates intended for sheathing purposes, for wire drawing, and for stamped work and jointed tubing. To some extent the demand for brass, and consequently for the zinc which is consumed in its manufacture, is governed by the same conditions which affect the demand for copper.

The largest quantities of slab zinc are used by the galvanizing industry. It is

Where Zinc Is Used With Copper—A Brass Foundry

*New Jersey Zinc Co.

employed to the greatest extent in coating sheet iron or steel, plain or corrugated, pipes, tubes and wire. Galvanized corrugated iron is one of our most used building materials. How the word "galvanized" came to be applied to all zinc-coated iron and steel is a mooted question. The word "galvanized" is evidently an Anglicization of the French word "galvanisé," which means "electroplated," and is never used by the French for hot galvanized iron. It is possibly true that the word was adopted by the English not to describe the method by which the zinc coating was produced, but to describe the manner in which it protects the iron, by electrolytic or "galvanic" action. The first tests on hot galvanization were made by a French chemist in 1741, who discovered that white iron could also be made by immersing sheet iron in a bath of melted zinc. Years later it was the chemist Sorel who made the process valuable and gave it a commercial field. His first patent is 1836, which gives the process of hot galvanization a period of development extending over almost a century. Sorel's process is in all essential respects the process of hot galvanization which is used today. Soon after this the galvanization of iron wire became a prosperous industry and the English factories took the lead, which they held for many years.

The first commercial galvanizing plants were operated on what is today known as the hand-dipped process. This produced a rather heavy and uneven coating on the surface of the articles. It was found, however, that the resulting product withstood the elements for a considerable number of years and impetus was given to the development of a process which today consumes about 50 percent of the world's supply of slab zinc. About 1840 the manufacturers of tin plate in England developed means of coating iron with tin mechanically, which so reduced the cost of manufacture as to seriously affect the sale of galvanized products. This led to the development of machines for the galvanizing of sheet and wire mechanically, which has resulted in substantial reductions in cost and improvement in quality.

The cold or electrolytic process consists in setting up the articles to be coated as cathodes in an electrolytic bath of soluble zinc salts, the anode being metallic zinc. Although known for about a hundred years, this process has been on a successful plane for only the last 25 years, due to former insufficient knowledge of the subject. It is now, in many cases, replacing galvanizing as it has the advantage of simple equipment, low maintenance, and little supervision.

In sherardizing, the parts to be coated are placed in a revolving drum along with zinc dust and a small amount of zinc oxide. While the drum is slowly rotated the zinc is vaporized by heating and evenly deposited, through tumbling on the parts. This process has the advantage of producing uniform coatings, and on threaded parts no appreciable variation in dimension is effected.

In the Schoop process the metal is sprayed upon the article to be coated by means of a special spray gun. Zinc in the form of wire is fed into the gun where an oxyacetylene flame melts it and a strong current of air projects it from the nozzle in the form of a fine spray. The coating can be made of any desired thickness.

In Europe the production of slab zinc has been closely linked with its use as rolled zinc for roofing. In 1811 Abbé Dony, the founder of the Belgian zinc industry, in his efforts to create a market for his small output of slab zinc, then practically a new and unknown metal, roofed a house with sheet zinc. During the same year portions of the roof of a church at Liége also were covered with sheet zinc. Roofs laid in those early days are still in good condition, giving conclusive proof of the suitability of zinc for roofing. The great durability and economy of zinc roofing appealed to European builders, and today their chief use of sheet zinc is for that purpose. While zinc has been rolled in this country almost since the inception of the industry here, the extension of its use for the covering of buildings has been far less active than in Europe. Additional rolling mills have recently started production, however, and the outlook is good for the consumption of a large tonnage in industrial and residential construction. Zinc's advantage in being the least expensive permanent metal roofing material makes the reason for its increasing adoption obvious, and particularly so in these days when labor costs make permanent construction and freedom from repairs so desirable.

Rolled zinc has many other important sales outlets from eyelets and grommets at one extreme to organ pipes at the other. Electric batteries use a large tonnage, as do automobile hub caps and running board moulding. Meter caps, alarm clock cases, washing machine parts and many other manufactures all take tonnages which in the aggregate are considerable.

Zinc dust was originally obtained as a by-product gathered at the beginning of distillation, but it is now distilled in furnaces especially designed and operated for the sole production of metallic zinc powder. Originally zinc dust served only for the purpose of a gray paint destined to protect iron against oxidation, the earliest known reference to its use being in 1840, by R. Mallet, an Englishman. Since that time it frequently has been referred to in treatises on painting. At the present time zinc dust paints are used almost exclusively for plant painting in the industrial districts of France, Belgium and Western Germany. It is also being used extensively in marine paints, both here and abroad. Sherardizing, dye-manufacturing and cyaniding are also important outlets for zinc dust. Along an entirely different line, the United States Navy has found that a most effective smoke screen can be made by the use of zinc dust.

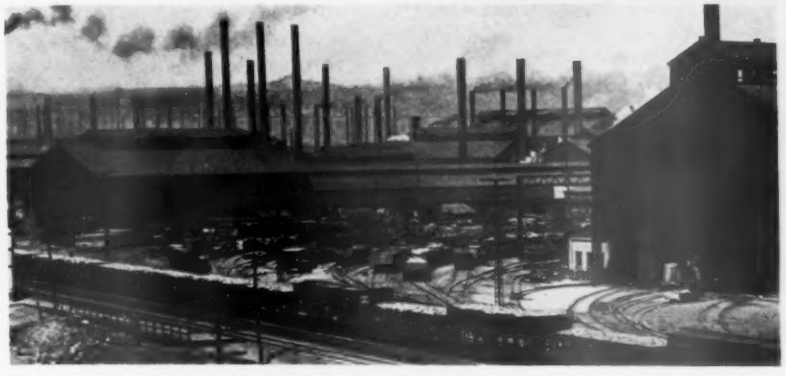
The 20th century has seen industries which are dependent upon zinc oxide as a raw material enjoy great expansion. To meet the increased demand the manufacture of zinc oxide has increased rapidly both in tonnage and in the number of producing plants. The chief users of zinc oxide, the paint and rubber industries, have grown phenominally. The sizeable production of zinc oxide as a pigment was started in France in the latter part of the 18th century by Le Clair. He was a paint grinder and master painter and was searching for a pigment which would not be injurious to the health of the workers. He found that zinc oxide in addition to being nonpoisonous, gave him a whiter and more desirable paint. The French Government investigated Le Clair's claims and specified zinc oxide for all government work.

The first zinc oxide produced in this country, as early as 1850, was made in reverberatory and muffle furnaces. The idea from which the present American process evolved was gained at the Newark plant of The New Jersey Zinc Company through the thoughtless act of a workman. This workman mended a badly leaking fire flue by throwing an old piece of fire grate over the exposure and shoveling over it a mixture of zinc ore and coal which was near at hand. A short time later he noticed a cloud of zinc oxide arising from the burning patch. One of the engineers of the company heard of it and was quick to realize the significance. Developments along this line followed, and led to many patents being taken out between 1852 and 1854, chiefly by Wetherill.

The principle of the American process is to vaporize the zinc directly from the ore instead of making metal first, thereby saving an extra operation. The reduction is by carbon, with the zinc vapor allowed to oxidize. In the process a mixture of zinc ore and coal is spread on the bed of burning coal lying on a perforated grate through which an excess of air is blown. The vapors are drawn through cooling pipes to muslin bags, which allow the gases to escape

through the meshes while retaining the pigment.

The French process for the manufacture of zinc oxide was first used in this country about 40 years ago. By this process slab zinc is vaporized in a specially constructed furnace and the volatilized zinc allowed to come in contact with an oxidizing atmosphere. In the early days, after the zinc oxide laden air was drawn through cooling pipes, the zinc oxide was allowed to settle in hoppers. About 1908 the present method was adopted, in which the hoppers are supplemented by muslin bags, which allow the pigment to be collected in the same way as in the American process.



Where Zinc Is Used For Coating—A Steel Plant

The first record of the use of zinc in the rubber industry in this country is a patent of 1849 for the "Improvement in the Manufacture of India Rubber Goods by means of Zinc Compounds." From that time until the automobile began its spectacular climb to favor the use of zinc oxide continued on a small scale in rubber compounding. The tremendous increase in tire output in the last 15 years has brought the present consumption of zinc oxide in rubber up to many thousands of tons annually. The chemists of 1849 did not appreciate the full significance of their invention. Rubber tire manufacturers have found that zinc oxide gives to their products superior aging, high heat conductivity, low hysterisis loss and activation of organic accelerators. With the extended use of reclaimed rubber zinc oxide provides, through its heat and age-resisting properties, together with its reinforcing effect, the essential factor of safety for such compounds.

As a paint pigment zinc was not generally accepted throughout the United States until a quarter century ago. A half century ago the prepared paint industry in this country was in its infancy and most of the paint used was straight lead ground in oil, which was mixed for the job by the painter. While at first zinc oxide made slow progress in changing the long-time habits of paint users to accept nothing but pure lead, the combination of properties not possessed by any other pigment gradually caused the paint industry to realize its value. Zinc oxide has the finest particle size of any paint pigment in common use. It is of excellent whiteness, has great hiding power and does not darken on exposure to the air or to the gases usually found in and about buildings and ships. It makes a paint durable for either inside or outside work. Now practically all first-grade prepared paints contain zinc oxide. Scientific research has developed new pigment combinations for both exterior and interior paint which have received widespread endorsement, and most of these pigment combinations include zinc.

Compared with zinc oxide, lithophone (ZnS and $BaSO_4$ precipitated) is a new pigment, but it ranks third in prominence among white pigments in use today. Like white lead and zinc oxide, it is an artificially prepared product but, whereas the manufacture of white lead and zinc oxide is more or less a matter of mechanical operation, in the manufacture of lithopone there is, besides, a great deal of chemistry involved all the way from the proper selection of the raw materials through to the finished marketable product. It is doubtful if any pigment now available in large quantities undergoes as much testing for control in the process as well as on the finished product.

Lithopone was discovered in 1874 by John Orr of Glasgow, Scotland, but the

Where Zinc Is Used As A Compound—A Rubber Factory

English did not recognize its possibilities and the Germans were the first to take up its production on a commercial scale. Some years later the French undertook its production without great success and they were followed by England and then Spain. During this time Germany remained the most successful producer and exported some to the United States. The manufacture of lithopone was introduced into the United States in the last part of the 19th century and managed to maintain a struggling existence because manufacturers of oil cloth found lithopone well suited to their purpose and began to use it in their process. Lithopone was later satisfactorily used in the manufacture of window shades. In 1906 lithopone had advanced to a point where it was recognized in a report of the United States Geological Survey. When the World War prevented the importation of German lithopone, production in this country boomed.

There were many faults in the early product and it is quite probable that the lithopone of 1915 would have been unsalable in 1920; it would certainly have been unsalable in 1925, as constant improvement resulted in 1920 in the elimination by a leading manufacturer of lithopone's greatest handicap, its property of darkening on surfaces exposed to moisture and sunlight. The many desirable characteristics of lithopone including, in addition to extreme whiteness, strong hiding power, moderate cost and easy working qualities were recognized as being valuable to the paint trade, and many interior finishes have for several years contained a large percentage of lithopone.

The improvement effected in lithopone by the elimination of the darkening property made it available for exterior as well as interior paints. Equal quantities of lead-free zinc oxide and highest quality lithopone, plus inerts adding durability and greater resistance to abrasion, have been combined to produce a first quality exterior paint in all respect equal and in some respects superior to other high grade exterior paint. This paint is the (*Continued on page* 670)

DOING IT TO ZINC

The Solution Of Utah's Problem Of Extracting Zinc From Refractory Ores Has Added Something Like Six Million Dollars Annually To The Receipts Of Mining Men Of That State, And Turned Annual Deficits Into Dividends

By A. G. MACKENZIE*

FOR many long years and until the recent past, whenever assays of Utah ores showed the presence of zinc in quantity the owners of the ores would curse, wail, mutter and sigh, according to their several natures or personal habits.

The reason therefor was that nature put the zinc with lead, copper, gold, silver and sometimes other metals in the same ore in Utah. The local smelters, which constituted the only available market for the Utah ore producer, were equipped to recover the lead, copper, silver and gold, but not the zinc, which long remained the discordant member of an otherwise fairly harmonious group. Accordingly, the smelters could absolutely be relied upon to "penalize" any ore that contained "excess zinc." They called such ores "refractory," and expressed their disapproval of them in terms of from 25 cents to 50 cents for each percent of a ton in excess of the allowable minimum, which minimum usually was somewhere between 5 percent and 10 percent of zinc and was determined by the other contents of the ore and the general character of the ore receipts at the smelter.

In consequence of which "excess zinc" frequently caused an otherwise respectable ore to lose all its friends overnight and its owner to suspect that the real hazards of mining began with the discovery of the ore instead of previously. Also, he believed that at least half of the lies told about the mining business were true. Sometimes he would undertake to prove statistically that all the lies told about the smelters were true, despite the oceans of red ink the smelters poured upon their records as a tribute to "excess zinc," which, they averred, crept surreptitiously into their furnaces and thence up the stacks, to the immediate loss of the smelter and the permanent loss of the world.

Many a polite tourist marred his reception and imperiled his physical welfare through innocent attempts to show intelligence by asking a mine manager how much zinc his mine produced.

*Secretary, Utah Chapter, the American Mining Congress.

Boutwell, U. S. Geological Survey
Daly West Mine, Utah

But today, if some of the grand old boys that fought zinc and other bedevilments in the founding of the state's great mining industry were brought to life they would be liable to drop dead again when they learned that Utah smelters have flocks of alert young men combing the mining camps for zincy ores; that they are buying mine dumps older than themselves; that they have brought long-deceased camps to life and vigor—all because they have learned how to do it to zinc instead of having zinc do it to them.

The dark cloud that was over western non-ferrous metal mining in 1921 had at least two silver linings. One was the silver repurchase clause of the Pittman Act, which kept a little animation in the industry through that period, and the other was the stimulus given to local metallurgists by the doleful situation and the direful outlook.

Everybody realized that something ought to be done. A few young fellows decided what ought to be done and did it. Not in a day, nor the first time they tried it. Details of how they did it are not pertinent here, and, in fact, have not yet been fully disclosed. The fact of importance is that they did it, and what they did was to part the lead upon the right hand and the zinc upon the left, so that each could and did go to its appointed place with profit, instead of loss, to its owner.

The process went into commercial operation in the fall of 1924. Its local significance is at least suggested by the fact that it has already added something like $6,000,000 per annum to the receipts of Utah mine operators and is still growing.

It is called selective flotation. Stated in simplest language, it consists of passing lead-zinc ore through one set of cells to recover the lead and then through another set of cells to recover the zinc. Or vice versa; it works both ways.

Several local plants now employ it. Prior to 1925, Utah's high mark in the production of recoverable zinc was 29,572,528 pounds in 1916—the big war year. In 1925 it was 45,368,000 pounds and today it is at the rate of about 170,000,000 pounds a year.

The local smelters are not equipped to handle the zinc product of the several Utah mills that now employ the new process and the zinc concentrate goes to outside points for treatment, most of it to Great Falls, Mont. This situation is not ideal, and there has been considerable local discussion of a zinc smelter more conveniently situated with reference to the source of the ore. A current production of fourteen to fifteen thousand tons a month of 50 percent concentrate from this immediate territory, with every indication of maintenance, or increase of that rate of production as markets may justify it, would mean a new payroll of three or four hundred men for some community and much more expeditious and economical handling of the material.

The man that makes two blades of grass grow where only one grew before has offered his bid for immortality on a mere 100 percent basis. Something should be done in the future to perpetuate the names and works of the group that made dividends grow where deficits grew before. And whatever is done should, of course, be done in zinc.

"Although the known lead resources of the world are gradually becoming exhausted, there was an increased output from many fields," says the year book of the Department of Commerce.

"In the lead industry the year 1925 was the best ever known. World production exceeded previous records and the New York price was the highest in the history of the industry.

SCIENTIFIC PROSPECTING

Geophysical Geologists And Scientists Are Attempting To Discover Some Method Whereby Valuable Hidden Ore Bodies May Be Discovered—Three Lines Of Research Covering Gravimetric And Seismographic Apparatus, Electric Devices, And Radio Wave System Are Being Developed

By DAVID W. BRUNTON*

THE steady decline in the mineral output of a number of our western states is due to the fact that the known ore bodies are being exhausted more rapidly than new ones are discovered.

The old type of prospectors who roamed over the hills with their burros and dogs have covered the field pretty thoroughly and probably most of the ore bodies with a visible outcrop have already been located. In addition to these surface discoveries, fortuitous occurrences have in countless instances revealed ore bodies slightly covered with soil or slide rock. A railroad grader's scraper when dumped showed a piece of freshly cut silver, and following back along the track of the scraper the outcrop of what became the La Rose Mine was exposed; persistent trenching in the shallow soil and muck nearby brought to light the wonderful silver mining district of Cobalt. Again, a man who knew nothing of minerals or prospecting, in order to justify a grubstake he had just received, dug into the soil and gravel in the comfortable shade of a pine tree—result, Leadville and a new Colorado. So many instances of this kind have occurred that it is an open question as to whether more of the mineral which has already been mined has come from exposed or covered ore bodies.

The zone of ore deposition is, of course, at a very considerable depth in the earth's crust, and when ores are exposed on the surface today it is because they have been reached by surface erosion. It is patent that all of the ore bodies in this earth's crust which have been produced either by rock replacement or fissure filling has not yet been reached by erosion, as has been proved by occasional discoveries in exploration drifts from deep levels in mines, which, in many instances, have disclosed the ore bodies whose apex has not yet been reached by surface erosion. A typical example of this kind was the discovery of the Silver King ore body at Park City, Utah, where a level driven for ventilation from the bottom of the Mayflower incline to the Silver King shaft cut the apex of a wonderful ore body whose upper edge only came a foot above the floor of the level.

Recently one of the largest mining companies in Mexico, from one of their deep levels, ran a series of what might be termed "wild-cat drifts," and one of these, which strangely enough ran away out under the valley, broke into a 16-foot vein of rich silver ore, which, when its strike and dip had been determined, was readily located under a few feet of wash on the floor of the plain.

Man now has reached the point where he can outspeed the denizens of the air, land, and water; can talk half way round the globe; can determine the temperature and composition of the stars; and it seems that the time must be nearly ripe for a discovery of some method whereby valuable ore bodies hidden from our view by a few feet of slide rock, soil, or even rock in place, could be located. Geophysical geologists and scientists are not neglecting this wonderful opportunity, and are working feverishly to discover some method of locating hidden ore bodies. Just what property or properties in minerals can be taken advantage of in this work is not yet fully determined. Buried or covered iron ore bodies have long been located with the dipping needles and magnetometer, but no such convenient property as magnetism has yet been discovered in the ores of the precious and semi-precious metals.

Lines of research in this direction point to three different fields:

1. Where fields of force surrounding mineral deposits can be investigated by gravimetric and seismographic apparatus.

2. Where fields of force are artificially produced and the variations in these fields caused by ore deposits are recorded by electric devices.

3. The radio wave system.

At the coming meeting of The American Mining Congress in September, it is expected that a number of scientific investigators in these different methods will read papers on the systems employed and the results obtained, and some of the investigators have already promised to exhibit their apparatus. By this means the Mining Congress hopes to focus the attention of the mining men and scientists on this all important problem in the hope that in the not too distant future ore bodies which today are out of our sight and ken will be readily located.

When the old time prospector wooed Lady Luck

*Consulting Engineer, Denver, Colo.

GEOPHYSICAL PROSPECTING AS AN ADJUNCT TO GEOLOGY

Scientific Prospecting Must Eventually Be Applied Particularly In Our Western Fields If New Deposits Are To Be Discovered—Well Organized Research Along Such Lines With Careful Technical Cooperation Will Lead To Development And Practical Application

By KARL L. KITHIL*

CONSIDERABLE interest has been shown during the past few years of study and investigation of sub-structural earth conditions in direct relation to the exploitation of our mineral resources. Comparatively little has been published in the literature on some of the methods which either have been successfully applied in practice or which show promise of successful application.

Whereas the electrical methods are being used here and abroad for the determination of hidden sulphide deposits and measurements with the torsion balance and seismographs have been made in the salt dome area of the Gulf Coast by the larger oil concerns, very little has been done in direct relation to the mining industry.

There is no doubt that some of these geophysical methods and systems will form a promising adjunct to geology proper, especially in territory where surface indications or outcrops are either hidden or where they are entirely missing, and this especially with reference to mining. All such methods which have been developed and are known and have been partially applied to practice are the result of several years' development and of a direct application of purely scientific and technical principles. They are free from any personal influences or idiosyncracies of the individual or operator. They must not be confused with so-called "doodle-bugs."

Very considerable work along these lines has been done in Europe and, only of late, in this country. It is a research which will eventually spread to greater dimensions and will in time bring about a completion of methods, the application of which will greatly benefit the development and exploitation of such of our natural resources, which without such means it will not be possible to disclose. Scientific prospecting, at least in our western fields, must eventually be applied if the recovery of hidden treasures from ground where old-time prospecting is no longer possible is to continue.

While there is considerable and splendid work being done now by direct geology with reference to ore finding, it will, in most cases even then, require great expenditure on the part of the mine operators to determine the correctness of such anticipations as were concluded from true geology. With the application of suitable methods in such fields and territory, it is not impossible to obtain further preliminary information and to confirm the speculations derived from the work of sub-surface geology at an infinitely smaller cost than by actual opening up of the ground by suitable mining and drilling methods alone, or by wildcat methods.

Great care must be taken in the selection of these new geophysical methods, as not all of these methods are applicable to any one ground or for any one purpose. This work is, therefore, a direct adjunct to geology and must go hand in hand with practical and economical geology.

There is no doubt that the study and further development of present known methods along electrical, gravitational, seismological, magnetic or other lines, including those methods relating to radio waves, is necessary before any definite statement can be made as to which methods or principles are the best to be employed on any one of the questionable grounds. Some data is published on these theories and methods, both from a theoretical as well as instrumental point of view, but it is fairly scattered throughout various literature. There is also much on the subjects in question which is known privately to individuals from experimentation which has not been published or made known. A well organized research along such lines and careful technical cooperation on the part of all those who are interested in this branch of science will lead to a much more rapid development and practical application of these methods in the field than is the case now.

The field is open for the geologist, the physicist, the mathematician, the scientist and the engineer as well. It leads to the development of a new type of technician, the assistance of whom, at this time, is difficult to obtain.

The cooperation of Colleges, Mining Schools, Government and State Institutions will bring about results which will eventually be of great benefit to the mining as well as to the oil industries and will prove of the greatest importance and benefit to the exploitation of our natural mineral wealth resources.

All of the various methods, based on different theories which have been outlined, have certain well defined individual values; and the proper application of any one of these methods, or any combination of them, in any particular territory or field, or for any particular purpose, will have to be determined before they are applied in practice.

By the proper selection and application of these modern methods, considerable money can be saved which heretofore has been expended for the opening up of uncertain ground. There is, furthermore, no doubt that, with the help of such geophysical methods, much can be learned of the construction of hidden earth ground and perhaps of its content. Such means should enable us, in time, to determine with a certain degree of accuracy what such conditions are and what may be expected in ground so to be tested.

(*Continued on page* 670)

Chinese Prospector Panning For Gold

*Denver, Colorado.

SCIENTIFIC PROSPECTING BY RADIO CAMERAPHONE

The Radio Cameraphone For Detecting Ore Bodies And Buried Metals Has Been Perfected From Similar Instrument Designed To Locate Oil And Gas Pools—Two Important Tests For Ore And Metals Have Been Made

By WM. A. SHARPE*

IT is with some hesitancy that I have consented to write a short article regarding the Sharpe radio cameraphone, because the results of the tests so far made have not yet been fully worked out. But the insistence of my long-time friend Mr. D. W. Brunton that I should supplement an article by himself, which will appear in this issue has persuaded me to contribute a few paragraphs.

The radio cameraphone for detecting ore bodies and buried metals has been perfected from a similar instrument designed to locate oil and gas pools, upon which considerable experimenting was done during 1924 and 1925 in Colorado and New Mexico. The detecting of different densities and compositions in rock beds, earths, fluids and gases proved a very delicate undertaking and requires innumerable tests to determine the individual reaction upon the instrument obtained from the many minerals and compounds encountered; and while the results have been as satisfactory and convincing as I could wish, the interpretations to me made from the readings,

The Author With Radio Seismograph Searching For Water At Gold Dust Mining Camp, Hillsboro, New Mexico

as applied to oil and gas, will be perfected only after much experience.

On the other hand, I discovered by experiment that metallic substances react in a positive and almost violent manner upon the instrument when a test is made. One of the earliest demonstrations of this was in a record obtained from a set-up that was made on the roof of a seven-story building in Denver, in which the radio camera photographed the steel beams of the seven floors below it with great clearness.

Recognizing the field that is open for more rapid exploitation in metallic minerals rather than in oil and gas, by use of the radio cameraphone, greater attention has been directed that way of late. Thus far two important tests have been made for ores and metals.

One of these is at the famous Meteor Crater in northern Arizona, where a giant meteor centuries ago buried itself in the earth. Shaft sinking and core drilling have been fruitless in the search for this metallic body, although countless fragments of the meteor are found for many miles around the crater and also buried in the earth, where they were distributed after the shattering that resulted from the impact.

The photographs obtained by the radio cameraphone show the main unoxidized body of the meteor to lie 100 feet south of the rim of the crater, the center of the body being at a depth of 1,410 feet, which is 200 feet deeper than any of the core drill or other tests heretofore have been made. The position of the meteor outside of a vertical plane extending downward from the crater's periphery is the result of the satellite striking the earth obliquely, which is indicated by the slant of the walls of the crater.

The second important test made by the radio cameraphone for ores and metals was in the Gold Dust section of the Las Animas mining district, Sierra County, southwestern New Mexico. The mineralization there consists of complex ores, mainly those containing lead, iron and manganese at the top of the limestone and those containing gold, silver and copper deposited in single veins or shear zones in the andesite. The instrument responds very sensitively to metallic enrichment in the veins and ore bodies, so that the lean and rich areas can be determined readily. In the tests that have been made there, 18 veins not heretofore exploited were found, and all of them have been more or less prospected since their discovery, with confirmatory results. One of them has been selected for more extensive underground work and a drift upon it has been in progress for six weeks, opening up about 60 feet in length, which has checked accurately with the results obtained by the radio cameraphone.

Operating The Radio Cameraphone At Meteor Crater

Following the veins with the instrument, I was led to the discovery of three old tunnels of uncertain antiquity that had been walled up at their entrances with stone and mud masonry and covered with gravel and earth, evidently for the purpose of concealment. Investigation revealed some native gold and copper and considerable ore bodies of tellurium.

The radio cameraphone consists of three units—the radio broadcaster, the radio receiver and the photographic motion picture camera. The broadcaster sends radio waves into the earth, extending to regulated progressive depths, the length of the wave advancing one foot at a time. This radio wave is returned by a (*Continued on page* 662)

* Sharpe Radio Seismograph Syndicate, Denver, Colo.

MARKETING PRODUCTS OF COMPLEX ORES

Close Operating Relationship Between Producer And Reducer Of Concentrates Would Bring About Better Understanding Of Each Other's Problems, And Would In The End Bring About What Both Desire — Higher Recovery And Greater Profits

By E. W. KEITH*

IN THE progression of effort to improve the grade of the products of separation, operators have advanced their practice to a degree where further accomplishment may be reactive in a commercial sense.

An increase in cost accompanies any split-hair milling practice; also there is a decreased recovery where extreme grades of product are forced.

The eternal struggle toward perfection in the separation of complex zinc and lead-bearing sulphides and in the reclamation of the contained metal suggests the desirability of a close operating relationship being established between the producer and the reducer of the concentrates. There are many advantages that can accrue through a more intimate knowledge of each with the complications the other has to contend in effort to abate their commercial wastage. The reducer of the concentrate to metal must satisfy critical fabricators with a character metal or product in order to realize high standards of price. Fabricators do not all require an extreme degree of purity or stabilized physical condition of their purchases, but do require a nicety of grade or character to conform with many specialized uses. The larger reducing organizations are in touch with the quality requirements of fabrications and often have lent guidance in suggesting means of improvement in compounding and alloying with beneficial results to both. It is not to be expected that the producer of concentrates can analyze the field of requirement of metal fabricators, but through reasonable familiarity with the scope and objectives of the reducer can lend assistance which is appreciable in both senses of the word. The assistance which the producer can contribute is on broader lines than that passed to the fabricator but notedly similar in the purpose of enhancing the net value of production, and it naturally follows that economies developed are subject to fair commercial division.

The problems with which the reducers of concentrates have to struggle are manifold. However, lack of uniformity of grade and irregularity of character tonnage supply, being uncontrollable, are consequently troubles which are continuous and the most hazardous. Reduction costs and metallic recovery, being so delicately governed by uniformity of analysis and evenness of furnace consumption, are the primary features to stress, as here the producers have their greatest opportunity to lend a helping hand. In blast furnace smelting there are many ingredients common in ores and concentrates that interfere seriously with a close lead recovery and the value of the bullion produced. The slab zinc recovery plants have difficulty in maintaining high recoveries on variable concentrates, with undesirable metal also resulting from impurities contained in their calcines. Any concentrate which contains an element interfering with theoretically perfect reduction practice adds its little quota in increasing the reducer's operating costs and is always considered in establishing the purchase value of the concentrate.

The reduction plant can not visibly penalize all deleterious elements without in many cases being seemingly discriminative. However, it is not to be doubted that in one way or another a penalty follows into the calculated purchase price. The producer of concentrates, being charged with the metallurgical losses and all other reduction and selling debits, has troubles that are not little ones in main, as in addition to bearing all cost items connected with reduction and transportation the producer still has a complexity of handicapping conditions to struggle with as individual operating problems. These difficulties begin with one similar to the reducer's basis problem; that is, with a lack of uniformity in the ore grade and character to be treated.

The fact that ideal separation can not be accomplished without perfect regularity in character and in durability of mill feed is an outstanding feature that faces all milling attempt, hence a subject to be kept open at all times in operating plants. An even feed to the separation plant means an even grade and uniform output of separated products; these passed to the reduction plants with dependable regularity create a commercial credit always worthy of the effort.

Next is the possibility of eliminating deleterious gangue elements in the milling practice or at least changing their position to better conform to the individual requirements of the reducer. Iron, lime, and lead, for instance, have no part in good slab zinc recovery, but are essential ingredients of any lead blast furnace feed. There are elements occcurring in small quantity in many ores that follow into the base metal recovered with a depreciating value effect due to the delicate final refinement of the base to the finished condition of each of the metallic elements the market requires. Some of these elements are recovered automatically in refining processes as by-products, with some credit perhaps, and as the actual consumption of metals other than zinc is usually in the form of alloys it is not improbable that the degree of refinement now applied to the base metal might be modified and a resulting greater quantity of natural alloy be found creditably marketable in that form.

This latter suggestion, however, is rather beyond the subject, except in its bearing on existing ore penalties and the possibility of the refining division passing backward a portion of marketing credit obtainable through a broadening of their demand requirements.

Producers and reducers are both inclined to weigh the others operating difficulties lightly and feel that explanations made bearing on marginal requirement are bunk or at least pessimistic. Any fixture of a perfectly equitable and standardized margin is always an impossibility, but as all profits come from the final realization value of the recovered metallic elements the outstanding feature is to make that recovery more valuable and have something further to divide. A smug attitude assumed by either the producer or reducer is a common bar to progress, as without some knowledge of the others operating limitations it is not possible to promote or formulate any of the many gainful objectives.

There is no industrial division which seems to contain the many compound features that surround the metallurgical, and with each step in further advancement there develops the keener necessity to consider means of correlating the existing complexity of personal ambition and interests. Commercial realization is the motive of the struggle, hence commercial consideration must be a part of the capitalization of all operating achievement.

The products recovered from complex ores by flotation concentration means are still somewhat (*Continued on page* 685)

*Consulting Mining Engineer, Denver, Colo.

TAX BOARD REVERSES REVENUE BUREAU ON AMORTIZATION

In A Lengthy Decision Of Far-Reaching Importance To The Mining Industry The Board Rules In Favor Of The Taxpayer—Chairman Of American Mining Congress General Tax Committee Filed Brief Opposing Commissioner

By McKinley W. Kriegh *

THE Board of Tax Appeals in deciding the appeal of the Manville Jenckes Co., holds that Section 1209 of the revenue act of 1926 disposes of and resolves in favor of the taxpayer, the contention of the Commissioner of Internal Revenue that no amortization deduction can be allowed in respect of the years 1918, 1919, or 1920 unless claim for such deduction was made at the time of filing the return for the year or years affected. Section 1209 was placed in the 1926 law by a Senate amendment which had been advocated by the General Tax Committee of the American Mining Congress.

The board also reverses the commissioner in respect to amortization deductions claimed in connection with facilities contracted for prior to April 6, 1917, but acquired and paid for subsequent to that date. The board holds that the order or contract dates are immaterial, and that since the facilities were constructed, erected, installed or acquired on or after April 6, 1917, they come within the amortization provisions of the revenue act of 1918.

Many claims for amortization deductions were held up in the department pending the determination of these questions by the appeals board. This decision, if acquiesced in by the commissioner, will mean many millions of dollars saved to the mining industry in taxes. Numerous manufacturing and other concerns also will benefit. The decision is particularly important to the copper industry.

Mining Industry Represented

As soon as the Manville Jenckes Co.'s appeal was heard by the board Paul Armitage, chairman of the General Tax Committee of the American Mining Congress, acting on behalf of mining and other companies interested, procured leave and filed a brief as *amicus curiae*, supporting the position that an amortization allowance should be granted irrespective of the date when the work was begun or planned provided it came within the law and the expenditures were made after April 6, 1917. In cooperation with Mr. Armitage, Wm. Wallace, Jr., of counsel for the Copper Producers' Tax Committee, filed a separate brief.

The board's decision also includes opinions in respect of questions of invested capital, determination of net income for the taxpayer's fiscal year ended June 30, 1917, and losses. But the amortization questions were of far-reaching importance, and the decision will be of interest to all taxpayers who have claims for amortization allowances still pending before the Bureau of Internal Revenue.

First Construction By Commissioner

The particular question involved was the construction of the provisions of the 1918 revenue act and subsequent laws allowing amortization of so-called war facilities. The 1918 law allowed amortization to corporate taxpayers "in the case of buildings, machinery, equipment or other facilities constructed, erected, installed or acquired on or after April 6, 1917, for the production of articles contributing to the prosecution of the present war." There was a corresponding provision applicable to individuals, and these provisions were continued in the later revenue acts of 1921 and 1924.

The commissioner provided in the 1918 regulations, and the Solicitor ruled, that it did not matter when the buildings, machinery, equipment or other facilities were planned or their erection started if they were not completed on April 6, 1917. Then the taxpayer was entitled to amortization on that part of the expenditures after that date if they were or could be used for the production of articles contributing to the prosecution of the war with Germany.

A large number of cases were adjusted under these regulations and rulings, and amortization was allowed in large amounts irrespective of the date when the contract for the facilities was entered into or the plan made for their erection. Of course, in each case the amortization allowance was only based on expenditures after April 6, 1917.

Attacked By Couzens Committee

The Couzens Committee attacked these allowances and charged that they were irregular and illegal on the ground that where the facility had been planned or commenced before the entry of the United States into the war, it was not within the scope of the law. The Couzens Committee then attempted to have the law amended by proposing a retroactive provision to that effect at the time the 1926 revenue act was under discussion in the Senate. This was defeated. (See Congressional Record, February 12, 1926, page 3600.)

But notwithstanding this clear expression by Congress of its intention, and despite the fact that a great number of claims had been allowed in large amounts and could not be changed or altered, the Solicitor of Internal Revenue rendered an opinion overruling the regulations which had been in force for several years and holding that where the facility had been planned, contracted for or started before April 6, 1917, no part of the expenditures thereafter made, although within the war period, were entitled to be considered in allowing amortization.

Mining Cases Held Up

The effect of this opinion was to immediately hold up all the copper cases which had been approaching or had reached a settlement on other questions. Particularly, it held up all those copper cases which had been in course of adjustment on the valuation and depletion issues. Furthermore, it held up many other mining and also oil and manufacturing cases which had been listed in the report of the Couzens Committee. These will now be settled in due course as soon as the commissioner acquiesces in the board's decision.

* Chief, Tax Division, American Mining Congress.

CHARACTERISTICS OF TENNESSEE COALS

INFORMATION in regard to the characteristics of a large number of coals of Tennessee is contained in Technical Paper 356, recently issued by the Bureau of Mines.

The Tennessee coal fields embrace two distinct physiographic areas, one known as the northeastern field and the other as the main Cumberland Plateau field. The coal beds in these two areas are distinct and different. The coal-bearing rocks of the Tennessee fields are of Pennsylvania age, but as the two areas have not been mapped in detail and systematically examined, the coals can not be correlated with certainty.

Copies of Bureau of Mines Technical Paper 356, "Analyses of Tennessee coals," can be obtained from the Superintendent of Documents, Washington, D. C., at a price of 15 cents.

WHAT IS WRONG IN COAL LABOR

The Miners Have Asked For Double Compensation Which The Consumer Has Refused To Pay—Efforts At Coercion But Increase The Public's Resistance, And Stimulates The Market For Substitutes—A Return To Competitive Spirit And Effort The Safe Road.

By GEORGE H. CUSHING

RECENTLY an inventor appeared in the market places with a new device. It was something that was needed. It promised a ready sale, hence it was known to be valuable. The inventor did not want to turn manufacturer, and there was no reason why he should, because several manufacturers were keen to add this new device to their line. Negotiations began briskly, but came to a dead stop so soon as the inventor had put his own price on his device. It was more than the manufacturers believed they could collect from the public. In his own behalf the inventor said:

"I know the value of what I have produced; so do you. I want to realize that full value; you say that you can not collect it. If the value is there and if you can not collect it, then it simply means that you lack the selling ability which I am seeking to employ. That means that I must look further to find a better salesman."

The reply of the manufacturers in their own behalf was:

"You have developed an idea which, as you say, has value. But to develop that value and realize on it, we must employ a large plant, a large force of men, a considerable quantity of capital, and great skill in merchandising. What you are asking for yourself is the value of your idea plus the value of all of these other things."

In the course of this interesting discussion, it developed that there is a price, even on an article protected by a Government monopoly, beyond which the public will not go. Rather than pay more the public will turn to substitutes. And the higher price at which the substitutes can sell—thanks to the existence of the patent monopoly—makes it attractive to other manufacturers to produce those substitutes. A well-known razor becomes a first-class illustration when such debates are in progress. Whoever tries to overcome the tendency of the public to resist extortion and to find substitutes for even a meritorious product—diamonds and rubies are no exception—is attempting what is well nigh impossible.

These homely truths about the production and sale of anything has a direct application to the coal labor situation around the world; they explain, excellently, what is wrong with the union miners. We have, at the moment, a most intense labor situation in the whole coal field. In the United States we had, until a few years ago, a situation where unionized labor was producing 65 percent and non-union labor was producing 35 percent of the bituminous coal. All of the anthracite is produced by union labor. Today the situation is almost exactly reversed. In the bituminous field, 70 percent of the coal is produced by non-union labor; practically all of the coal now being sold overseas is being produced by non-union labor. Therefore, in the union field, the southwestern districts quietly abandoned the union and made other arrangements. In the eastern fields the union mines closed and soon opened as non-union mines. In the central competitive field part of the union mines are closed, and two big districts are vigorously fighting to free themselves from union dominance.

In Canada, until a little more than a year ago, practically all of the coal was being produced by union labor. Today the whole of western Canada coal is non-union; the Nova Scotia mines are still union, but there is a schism in the ranks of the union, due to which production is seriously curtailed.

In England the coal mines have been closed for four months because all of the coal was produced by union labor, and the coal owners proved that they could not meet the union's conditions and at the same time meet Germany in competition.

In Germany they have unions, but not the union conditions which are found in England, Canada, and the United States. Therefore Germany can undersell the world on coal—and is doing it.

In South Africa there is union control, and the coal situation has drifted into national politics, as it has in the other countries where unionism is a vital force. But while South Africa has considerable coal of some value, its cost of production is so high that Germany can sell her own coal in those markets at the German cost of production plus the charge for a long haul by water.

The last month brought to the United States a delegation representing the British miners. They have come here to beg for money with which to carry on their fight against the British coal owners. Eight months ago the anthracite miners were begging for money from the public and the other unions with which to carry on their fight against the operators. Since 1922 the Miners' Union has been asking the Federal Government to come to its relief and insist that the operators grant the terms which the miners believe they are entitled to. Mr. Lewis went so far last November as to demand of the President that he intervene in the anthracite strike in behalf of the miners and that he take a hand in the enforcement of the Jacksonville scale.

By the last recited series of facts, it may be said that the whole question of coal labor has been fairly presented to the public for consideration and decision. Therefore it is proper to analyze the coal labor situation in an effort to find what is wrong with the demands of the miners' union.

Some two years ago an organized group in Washington decided to stage a discussion—a sort of joint debate—on this question and invited as speakers the author of this article and Mr. Bittner, one of the vice presidents of the Miners' Union. Mr. Bittner took almost precisely the same position as did the inventor who was quoted at the outset of this article. He said that the miners are producing something of value. In order to produce it they are taking certain risks. They should have the value of what they produced and should be paid for the risks they take. He intimated, very broadly, that the operators were rather indifferent salesmen if they could not collect for the coal a price which would pay the miners a fair wage. He said, bluntly, that the public was unjust to the extent that it refused to pay the miners a wage which was commensurate with their effort and their risk. He did not go so far as did the inventor by saying that if the present group could not collect the money the miners would seek another group which could do so. The inference in that direction was, however, strong.

Meanwhile, the public has passed upon the question which Mr. Bittner raised and upon the question which the English delegation has come to this country to raise. In the case of anthracite, the consumers have said that the labor cost of producing anthracite may be inevitable but they can and will use something else. The action of New England last winter in using non-union coal is, of course, generally known. The aftermath, however, is interesting. This writer has recently had extensive relations with executives and mechanics in some New England factories. Until last year everyone of them was a user of

anthracite. Today not one of those with whom he came in contact is using it. Some of them are using oil; others are using various combinations of other hard fuels. It is not, therefore, a question of the ability of the operators to sell anthracite; it is a question of the ability of the people to find substitutes. In England precisely the same situation has developed. British coal is excellent. The British coal owners are consummate merchants. It is not a question of the appeal which the coal makes; it certainly is not a question of the ability of the merchants to get the price. The decision swings on the ability of the people of the world to find a satisfactory substitute for the British coal. They are able to get that substitute in Germany, and they are going to Germany for it.

In the light of those gripping facts, it is worth while to turn attention to the demands of the miners' unions everywhere. In the United States the Miners' Union demands a minimum wage of $7.50 a day, when the non-union labor, on the opposite bank of the Ohio River, is willing and eager to work for $4.40 a day. That difference of $3.10 a day within a radius of a hundred miles, or such a matter, is far too much of a handicap for the union operators to overcome. The over-advertised "hazards" of coal mining are, incidentally, the same in both districts. The non-union miner believes he is sufficiently paid at the lower wage; the union miner has no sufficient reason for demanding the higher. But to set up the contention of hazardousness is idle in view of the fact of t lower rate in the adjoining field.

The union does not stop with the mere matter of wage differences. It has imposed an ironclad and burdensome set of "working conditions" upon the union field. These working conditions involve a division of the volume of labor among a far larger number of men than are employed in the non-union field.

That, incidentally, is the same situation in England. The main trouble in Great Britain, in fact, is not the wage but the working conditions. The men there have split up the jobs so finely that each worker does but little for the pay that he receives. And England is competing with Germany where the miners actually work.

The net result is the conclusion that the miners' unions everywhere have tried to take a double compensation. They have tried to get an artificial wage scale by a process of monopolizing mine labor. Then they have tried also to bring about an artificial reduction of the amount of work that would be done for that given quantity of money. They have asked the operators to add the cost of these two concessions to the price of coal and have complained to the whole world that the operators are poor salesmen because they can not collect the indicated amount. The fact is that the resulting artificial price for union-produced coal has raised the price of fuel to a point where the production of substitutes becomes attractive to other manufacturers. Those substitutes are being produced and used in quantity. When the miners have seen this tendency, they have tried to coerce the public by shutting off its supply of coal. This has so aroused the public that the favor shown to substitutes is increasing.

Seeing the facts, one is inclined to conclude that the miners have tried for a monopoly and have tried to free themselves from the need to compete. Their present difficulties are the result of that mistaken effort. Their road to safety—and the road to safety for the coal industry—would seem to lie in the direction of a return by the miners to a competitive spirit and effort.

A. E. S. C. YEAR BOOK SHOWS HEALTHY GROWTH IN STANDARDIZATION MOVEMENT

THE movement toward standardization of industrial products has been considerably extended during the past year, and savings from standardization work are constantly growing in magnitude, according to the Year Book of the American Engineering Standards Committee, just issued. More than 200 definite standardization projects are in process or completed under the auspices of the A. E. S. C., and 365 national trade associations, technical societies and Government bureaus are cooperating in the work through some 1,600 representatives.

The general adoption of a comprehenhensive system of limit gaging developed by a representative committee of experts under the A. E. S. C. and approved during the past year, can, it is estimated, produce savings for American industry approaching a billion dollars a year. Two other projects of wide importance and interest are the standardization of drafting room practice, so as to provide a desirable uniformity in the methods and conventions of mechanical and other drawings used in industry; and the standardization of the methods of graphically presenting facts, both of which are to be undertaken through committees of experts.

Progress has been made on some 50 safety codes applicable to factories; and codes for paper and pulp mills, elevators and escalators, and for manufactured gas, were completed and approved.

Nineteen standardization projects dealing with the mining industry are now under way. A very important code covering the rock dusting of coal mines to prevent the coal-dust explosion hazard was recently approved. The casualty insurance companies which cover mine insurance have announced through the associated companies that they will in future not issue compensation policies on gaseous or dusty mines that are not rock-dusted, and that after October 1 they will cancel policies already in force on such mines.

For the convenience of American industry, the A. E. S. C. is maintaining a file of specifications to be sold at cost. These include standards issued by all of the foreign standardizing bodies with which it regularly exchanges in formation and standards, and also those of all the national trade associations and technical societies in the United States which have issued standards and specifications. This is done as a means of cooperation in the important work represented in the National Directory of Commodity Specifications, recently published by the Department of Commerce.

The A. E. S. C. maintains an extensive file of specifications that are constantly referred to by engineers and experts in every field. About 7,000 standards are available for examination and reference in this way. This information service is of value to exporters, who have the problem of supplying goods to a distant purchaser in accordance with standards of material or dimension originating in a foreign country.

There has been a marked increase in interest on the part of industrial executives in regard to the standardization movement, and it is more and more recognized by management that standardization has an important part to play in the improvement of the processes of industry, in broadening its markets and in reducing costs of production.

The membership of the A. E. S. C. now consists of 19 national trade associations, 9 national technical societies, and 7 governmental departments. Mr. Charles E. Skinner, assistant director of engineering of the Westinghouse Electric and Manufacturing Co., is chairman of the committee, and Mr. Charles Rufus Harte, construction engineer of the Connecticut Co., is vice chairman. Its advisory committee of industrial executives is composed of: Messrs. J. A. Farrell, president, United States Steel Corporation; George B. Cortelyou, president, Consolidated Gas Co. of New York; J. W. Lieb, vice president, New York Edison Co.; L. F. Loree, president, The Delaware & Hudson Co.; Gerard Swope, president, General Electric Co.

Copies of the Year Book may be had upon application to the office of the American Engineering Standards Committee, 29 West Thirty-ninth Street, New York.

Triumph Steel Corporation's Plant

STEEL FROM OCEAN SANDS

*A Plan To Make High Grade Electric Steel And Ferro-Alloys From The Beach Sands Of California—A Digest Of A Paper By J. Harris Mackenzie**

A UNIQUE plant for the recovery of magnetite, martite, chromite and ilmenite from the beach sands of Monterey Bay has been built at Cristo, California, by the Triumph Steel Corporation, San Francisco.

The process embodies two steps, the separation and classification of the ores and their subsequent reduction.

The blacksands carrying these minerals are found along most of the shores of the Pacific Ocean. It is said that some of the concentrates run as high as 50 percent by weight, in magnetite, with other alloys in commercial quantities. The statement is also made that gold and platinum are also recoverable.

The Triumph Steel Corporation plant includes two miles of beach frontage and 19 acres of plant site. The sand in place averages 30 to 45 per cent metallic oxides, of which 82 percent are iron, 16 percent ilmenite and 2 percent chromite. The plant is served by a spur of the Southern Pacific Railroad.

The operating plant, located above tide, receives its raw material by dragline scraper, the sand being dumped into a hopper from which it is elevated and fed into an internally fired revolving hopper. The dry sand is then elevated to a bin directly above an electromagnetic separator and classifier of special design.

The present capacity of the plant is 400 tons per day. The sand passing through the first process loses its magnetite; the next step removes the martite; the last process recovers the chromite. There remains in the tailings nothing but the silicates and such gold and platinum as may be carried. It is claimed for the process that a 99 percent concentration results.

The company proposes to make:

1. Briquettes of ore and carbon, for electric furnace reduction to steel, or to resuscitate old metal.

2. Welding powder, by the addition of finely powdered aluminum.

3. Much-bar or "wash metal" by passing magnetite through an atmosphere of volatilized hydro-carbon or crude oil, with free oxygen excluded. During its passage the oxygen is removed from the magnetite and the resulting metallic iron is molded into billets. The gases are scrubbed and utilized as fuel.

4. Steel billets of high grade, from magnetite, carbon and lime melted and refined by Heroult electric furnace.

5. High grade alloy steel by mixing magnetite with various alloy-oxides, carbon and binder, and passing the mixture through an extrusion-press, forming electrodes, which when baked are used in the Heroult furnace. These electrodes when melting down in the furnace are reduced to metallic form.

It is claimed for the Triumph process that purer pig can be manufactured with much less expense for equipment and operation, and that the plant is the first large scale utilization of beach sands for this purpose.

The patents and development are the work of Don M. Crist, and the aim of the company is to produce a superpure electric steel, and alloys. It is proposed also to manufacture a special grade of tough mill-balls, and to develop improved methods for re-working tailings.

* Secretary, Triumph Steel Corporation.

STUDY OF ALABAMA RED IRON ORES

A STUDY of the red iron ores and iron-bearing sandstones of the Clinton formation in the Birmingham district, Alabama, has been made by the Bureau of Mines. The four ore beds in Red Mountain would become important sources of iron should a satisfactory method for beneficiating the high silica ores be devised, it is pointed out. Such a method would apply equally well to the associated ferruginous sandstones.

Although much information is available on the grade of the iron ores in the Birmingham district and numerous analyses of these ores have been published, no attempt has been made to investigate the ores systematically with respect to variations of composition along the strike and down the dip, states W. R. Crane, superintendent of the Bureau's Southern experiment station.

The object of Technical Paper 377, by Dr. Crane, just issued, is to show the amount and the grade of all the ferruginous materials of the Clinton formation in the Birmingham district, including the ore beds.

The ores are hematites and lie as bedded deposits in Red Mountain, which extends northeast and southwest between Birmingham and Bessemer and beyond, although the most important part of the district is between the cities named. The ore beds are in the Clinton formation, of Silurian age, which is 200 to 300 feet thick, and is composed largely of sandstone and shale.

There are four ore beds in this formation, but only two produce ore suitable for making iron by present conditions. However, as the results of the investigation made by the Bureau of Mines cover all possible sources of iron, all ferruginous materials in the Clinton formation are considered and include, therefore, all beds of relatively high iron content.

The so-called ore beds from above downward are the Ida, the Hickory Nut, the Big Seam, and the Irondale. The beds of ferruginous sandstone between the Hickory Nut bed and the Big Seam and above the Ida bed are thick and in certain places have a surprisingly high iron content. If it were possible to mine and utilize this sandstone as well as ore from the four beds mentioned, the materials available for iron making in the district would be greatly augmented.

Detailed information in regard to the occurrence of these ores, the extent and thickness of ore beds, and the character of the ores is contained in Bureau of Mines Technical Paper 377, copies of which may be purchased from the Superintendent of Documents, Washington, D. C., at a price of 10 cents.

METALS

PRACTICAL OPERATING MEN'S DEPARTMENT

GUY N. BJORGE, Editor

Practical Operating Problems of the Metal Mining Industry

SAMPLING AND ESTIMATING THE WEST ORE BODY OF SACRAMENTO HILL

Actual Mining Corroborates Prospecting Estimates—Churn Drill Samples Taken Every Five Feet—Ore Tonnage Computed By Triangular Prismatic Method—Copper Content Taken By Colorimetric Method In Five Minutes

By H. M. ZIESEMER*

IN sampling and estimating the West Ore Body of Sacramento Hill, which is a disseminated deposit of copper sulphides in porphyry, it is recognized that errors occur in both operations. In the actual mining of ore there is an economical point, beyond which sampling and records cannot be carried.

Contrary to what is generally found to be true, that actual mining does not hold up to estimates, and some factor of safety should be applied, the reverse has been the case with the work to date in the West Ore Body. Conventional methods of estimating were not followed, which may account for this reversal, yet an estimate which has proven very conservative and allowed for a margin over actual mining has been the result. The methods of sampling, calculations and deductions may be of some interest to others, so will be described in detail.

The first exploratory work in the Sacramento Hill porphyry stock was done by underground methods; namely, drifting and raising at different elevations. Twenty-four hundred feet of drifting and 500 feet of raising at an elevation of 5,295 (all elevations refer to sea level), 4,500 feet of drifting and 2,800 feet of raising at 5,178 elevation and 4,200 feet of drifting and 2,000 feet of raising at 5,129 elevation. By this exploratory work it was proven that there existed an ore body of considerable extent, but varying greatly in the copper contents over short spaces. To prove the tonnage and the grade of the ore, churn drilling was resorted to. Where drilling and sampling are carefully done, very accurate information is obtained at a minimum cost. All underground exploratory work was carefully channel sampled, but outside of a very few raises the results were not used in calculating the ore reserves, so the methods of raise sampling can be disregarded.

A total of 46,190 feet of churn drilling was done within the limits of the West Ore Body. The holes averaged a depth of 515 feet, starting with a 10½-inch bit and bottoming with a 6-inch. Casing was put in when ravelly or caving ground was encountered. The first drilling was done on the corners of 200-foot squares, but as work progressed it became apparent, if a fairly accurate estimate was to be obtained, it would be necessary to drill at closer intervals. Accordingly, holes were put down on the corners of 100-foot squares, being

Fig. 1. *Phelps Dodge Operations At Sacramento Hill, Bisbee, Ariz.*

* Chief Engineer, Sacramento Hill Operations, Copper Queen Branch, Phelps Dodge Corporation, Bisbee, Ariz.

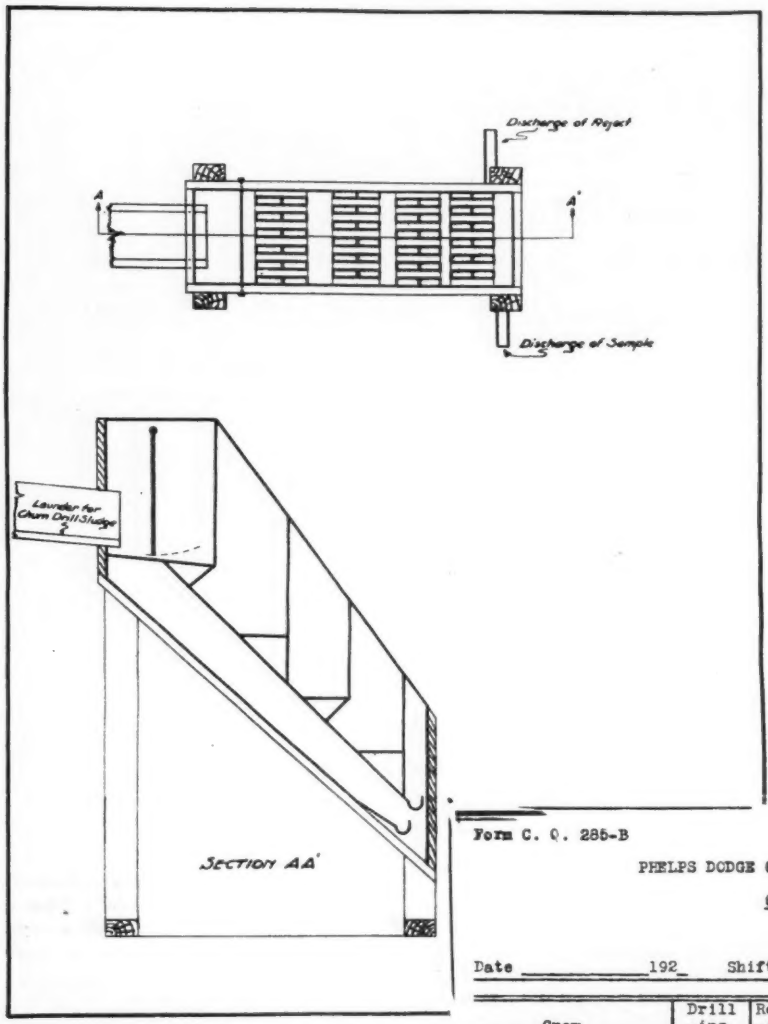


Fig. 2

Phelps Dodge Corporation, Copper Queen Branch, Sacramento, Hill Churn Drill Sampler

lettered in one direction and numbered at right angles to give a ready reference to their logs. They were located and mapped by the coordinate system used throughout the district and the elevations of the collars of the holes were referred to sea level.

Sampling of each churn drill hole was done at 5-foot intervals. At the completion of five feet of drilling as much of the sludge as possible was removed by the bailer. The sludge from each five feet of drilling was put through a Jones splitter. (See drawing).

A sample having an approximate weight of 50 pounds was desired for the assay laboratory. A repetition of splitting was necessary where the amount of sludge was too great. The sludge, after going through the splitter, was dried in the upper half of a cylindrical drum about four feet in diameter and a foot high. The lower half of the drum consisted of a chamber to which live steam from the boiler was admitted, supplying the heat for expelling the moisture from the sample. It was then sacked, labeled and taken to the assay laboratory where it was further reduced by mechanical grinding and splitting to the required size for analysis. Errors undoubtedly enter the sample through these operations and cannot be eliminated, but all work must be carefully done so as to give a sample that will be as reliable as possible. The driller filled out the upper half, the sampler the lower half of the form shown in Fig. 3.

These reports form a permanent record in the Engineering Department.

The analyses of the samples from the Assay Laboratory were reported to the Engineering Department as a permanent record on the form shown in Fig. 4.

The log of the hole was recorded on cross-section cloth, the details of which are shown in Fig. 5.

In estimating ore bodies from churn drill holes, what is known as the "Standard Method" is generally used. To find the tonnage, the cubic contents of triangular prisms, in the apices of which the drill holes are placed, is found by multiplying the horizontal area of the triangle by the average depth of the ore in the three holes and then multiplying the cubic contents by the spe-

Form C. Q. 285-B

PHELPS DODGE CORPORATION, COPPER QUEEN BRANCH

CHURN DRILL REPORT

Date _____ 192_ Shift 7-3 / 3-11 / 11-7 Hole No. _____ Drill No. _____

Crew	Drill -ing	Ream -ing	Fish -ing	Cas- ing	Repair -ing	Power Off	Mov- ing		Lost Time
Drillers									
Helpers									
Sampler									

DRILLING

DRILLING: Began with Bit as	Ft.	REAMING: Started at	Ft.
Depth of Hole End of Shift	Ft.	Depth End of Shift	Ft.
Depth Hole Beginning Shift	Ft.	Depth Beginning of Shift	Ft.
Depth Hole Made During Shift	Ft.	Depth Made during Shift	Ft.

CASING: Put in	Ft. Of		Inch Casing
Taking Total of	Ft. Of		Inch Casing
Pulled Out	Ft. Of		Inch Casing
Left in	Ft. Of		Inch Casing

ROPE:	Taken off	Ft.	Put On	Ft.				
TOOLS:	Working Free		Sticking		Lost		Recovered	Left in Hole
GROUND:	Standing Up		Caving		Hard			
WATER:	Struck at							

Sample at	Granite Porphyry	Highly Oxidised Rock	Pyritiferous Porphyry	Massive Pyrite	Oxidized Limestone	Pyritized Limestone	No. Bailings	Sample Saved	Sample Discarded	Sample Reliable	Sample Unreliable	Remarks

Sampler.

Fig. 3

cific gravity of the ore or rock. The assay value is found by dividing the sum of the products of the depth of ore in each hole and the corresponding assay value, by the sum of the depths of the ore in the three holes. This method of figuring ore reserves, sometimes modified to give closer results, when the triangles are not equilateral, will doubtless give figures which are very reliable as to total tonnages and grades for a large ore body, but will it check actual mining results in an ore body where there is a wide variation in assays over short spaces and steam shovels are to be used? The mining of the West Ore Body was governed by these conditions and it was thought that a closer estimate could be obtained by modifying the "Standard Bulk Method" to individual estimates covering each bench to be mined. As the material near each hole would become fixed on being shoveled, the average assay value for each hole for each depth of bench was figured. The tonnage for each triangular prism for each bench was found by the "Standard Method." Multiplying one-third the tonnage in each triangular prism by the average assay value of one of the holes at the apices and segregating to classes as governed by the average assay value of the hole gave the assay-tons for that class of material in each triangular prism. Dividing the sum of the assay-tons for each class of material by the total tonnage of that class gave the average grade for that class, which was worked out both as to different benches and as to total.

The specific gravity of the material, which varied greatly throughout the pit, was determined from an average of numerous specimens from various locations by loss of weight when submerged in water. The low grade materials showed an average specific gravity of 2.22 and the higher grades of 2.67. The average specific gravity of the higher grades for 1923, 1924, and 1925, were 2.70, 2.64 and 2.59, respectively. These later determinations were figured from the measurements of the material sent to the Concentrator and the weights of same as recorded there.

All triangular prisms were not equilateral in cross-section, but were laid out as nearly so as possible. A comparison between the results obtained and those, if the "Standard Method" were used on a 30-foot bench for an equilateral triangular prism, is shown by the figures in Fig. 6.

Tabulating the figures from churn drill holes, the total reserves of the West Ore Body above the 5,210 Bench were estimated as shown in Table I.

174-B PHELPS DODGE CORPORATION, COPPER QUEEN BRANCH

MINE DEPARTMENT, BISBEE, ARIZONA

ASSAY AND ANALYSIS CERTIFICATE

Division _____ Samples Assayed _____ 192_

LEVEL	Stope or Drift	Gold Oz.	Silver Oz	Cop'r %	Lead %	SiO_2 %	Al_2O_3 %	Fe %	CaO %	S. %

Fig. 4

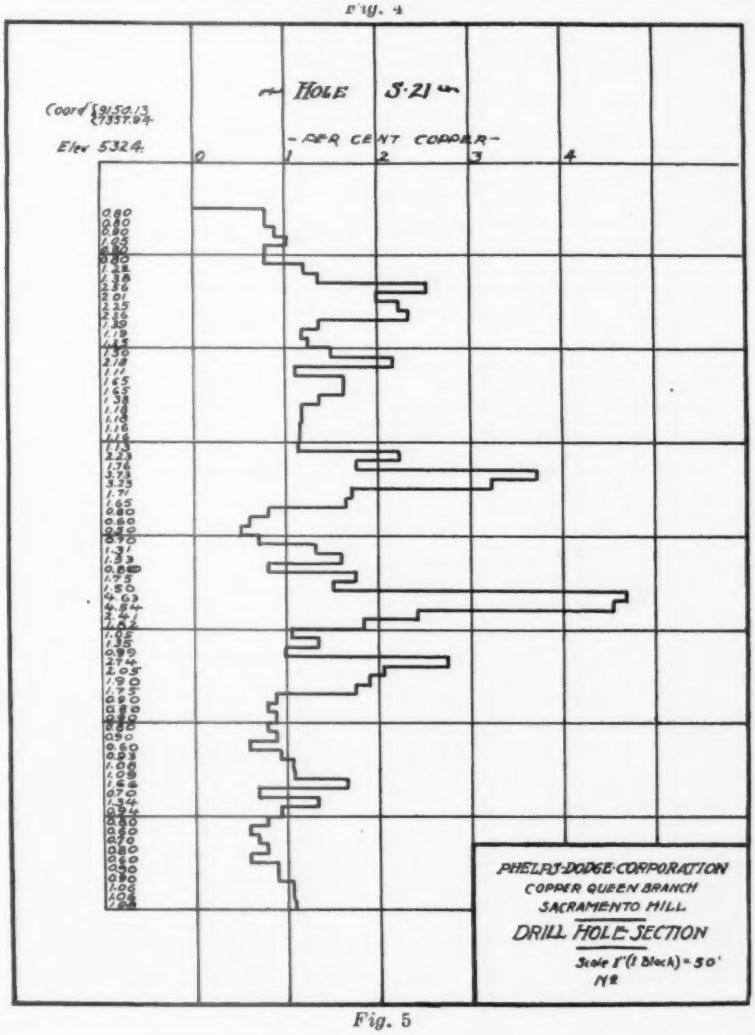


Fig. 5

Table I

Bench	1.00 Percent and Above Tons	1.00 Percent and Above % Cu.	0.80 to 1.00 Percent Tons	0.80 to 1.00 Percent % Cu.	Ore and Waste Tons
5540	.....	....	.....	....	624,653
5480	.....	....	.....	....	1,643,492
5420	.....	....	.....	....	2,817,279
5360	.....	....	.....	....	4,147,885
5315	284,191	1.55	55,230	0.83	4,064,811
5270	796,933	2.04	89,219	0.79	3,904,442
5240	807,247	2.13	218,227	0.85	2,306,822
5210	773,759	2.03	200,985	0.83	2,064,260

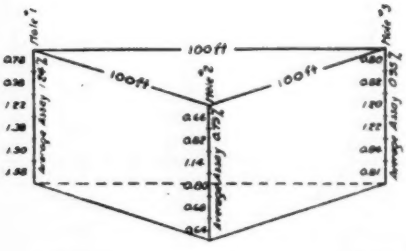

100 ft
100 ft
100 ft
Area of Prism 481125 Sq Yds
Volume of Prism (30 feet thick) 4811252 Cu Yds
Tonnage of Prism (2.16 Tons per Cu Yd) 10392304 Tons

Table II

Month	Tonnage	Hill % Copper	Mill % Copper	Percentage of error
January, 1924	117,140	1.75	1.66	+5.42
February, 1924	117,572	1.78	1.65	+7.88
March, 1924	121,961	1.80	1.78	+1.13
April, 1924	125,994	1.65	1.72	—4.07
May, 1924	145,621	1.57	1.50	+4.67
June, 1924	147,678	1.70	1.59	+6.91
July, 1924	119,261	1.48	1.50	—1.33
August, 1924	156,360	1.64	1.68	—2.44
September, 1924	135,326	1.51	1.54	—1.95
October, 1924	99,530	1.39	1.42	—2.11
November, 1924	104,452	1.37	1.30	+5.38
December, 1924	124,314	1.59	1.63	—2.46
January, 1925	138,904	1.65	1.82	—9.33
February, 1925	107,371	1.98	2.16	—8.33
March, 1925	130,510	1.73	1.90	—8.95
April, 1925	94,008	1.59	1.67	—4.76
May, 1925	123,282	1.52	1.68	—9.52
June, 1925	104,034	1.48	1.57	—5.73
July, 1925	100,772	1.23	1.16	+6.04
August, 1925	113,655	1.31	1.28	+2.31
September, 1925	108,500	1.23	1.29	—4.65
October, 1925	109,396	1.16	1.18	—1.70
November, 1925	93,703	1.50	1.49	+0.67
December, 1925	106,778	1.50	1.64	—8.54

- Standard Method -

Hole	Thickness of Class of Material			Aver Per Cent Cu	Average Per Cent Cu			Tons of Material			Pounds of Cu			Pounds of Copper
	1.00 & +	0.80-1.00	0.50-0.80		1.00 & +	0.80-1.00	0.50-0.80	1.00 & +	0.80-1.00	0.50-0.80	1.00 & +	0.80-1.00	0.50-0.80	
1	20'			1.42	1.42			2303401			65387			65387
1		5'		0.98		0.98			577.350			11316		11316
1			5'	0.78			0.78			577.350			9007	9007
2	5'			1.14	1.14			577.350			13163			13163
2		10'		0.81		0.81			1154.700			18706		18706
2			15'	0.66			0.66			1732.050			22863	22863
3	10'			1.21	1.21			1154.700			27944			27944
3		20'		0.82		0.82			2309.401			37894		37894
3														
Total	35'	35'	20'		1.32	0.84	0.63	4041.451	4041.451	2309.400	106696	67896	31870	206460

- Copper Queen - Steam Shovel Method -

1	30			1.26	1.26			3464.101			85910			85910
2			30	0.79			0.79			3464.101			54732	54732
3		30		0.95		0.98			3464.101			65818		65818
Total	30	30	30		1.26	0.98	0.79	3464.101	3464.101	3464.101	85910	65818	54732	206460

Fig. 6

After stripping operations had progressed to a stage where ore was being encountered, methods were provided for recording mining results. Four divisions of the material from the pit were made, namely, below 50 percent copper was sent to the waste dump, 0.50 to 0.80 percent copper to the No. 2 Leach Heap, 0.80 to 1.00 percent copper to the No. 1 Leach Heap and above 1.00 percent to the Concentrator or Smelter. A fairly accurate and speedy method of sampling and assaying was worked out to take care of the segregation of the material.

Each train is made up of five cars hauling a total of 200 tons of material. A sampler, as soon as a car is loaded, goes over the top and takes from 10 to 12 shovel-fulls of the material which is thrown into a receiving tray on the ground, where the helper breaks it to pass an inch opening. This operation is repeated for the first three cars loaded and this serves as a sample for the entire train. The amount of material weighs from 150 to 200 pounds and is then put through a splitter which cuts out one-quarter as a sample. The split sample is then hurried to the bucking room of the assay cars, which are mounted on flat cars so as to be movable from one location in the pit to another.

It passes through a 5-inch by 8-inch jaw crusher, 10-inch rolls, splitter, dryer and pulverizer, where it is reduced for assaying. The arrangement of the bucking room and assay laboratory is shown by the following drawing:

In the determination of the copper contents of the material in the pit laboratory, the colorimetric method is used. Fairly accurate determinations are made. The time factor which is so important (so as not to delay operations) is reduced to a minimum—from the time the pit sample arrives at the bucking room to the determination of the copper contents, five to six minutes have been consumed. The assayer 'phones the destination of each train to the dispatcher, who routes it accordingly.

A record of each shovel shift's operation is kept on the following form:

By a comparison between the mill heads each month and the results obtained from pit sampling and assaying of material sent to the mill, the percentage of error in pit work is determined. All pit records are then corrected by the percentage of error shown,

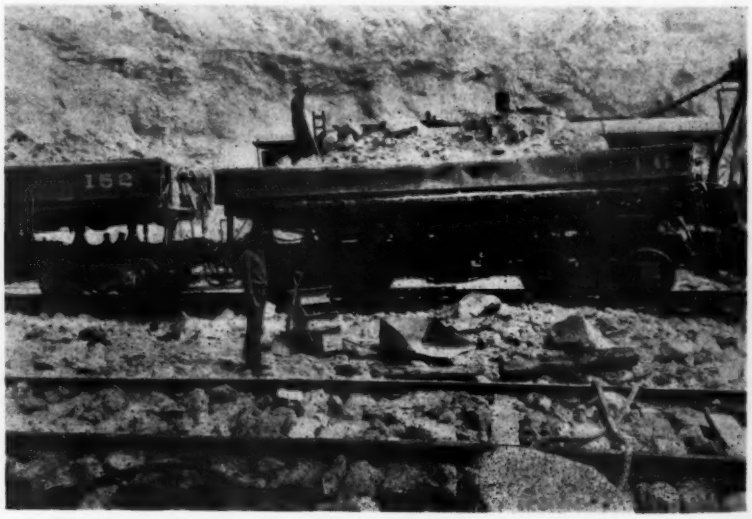


Fig. 7

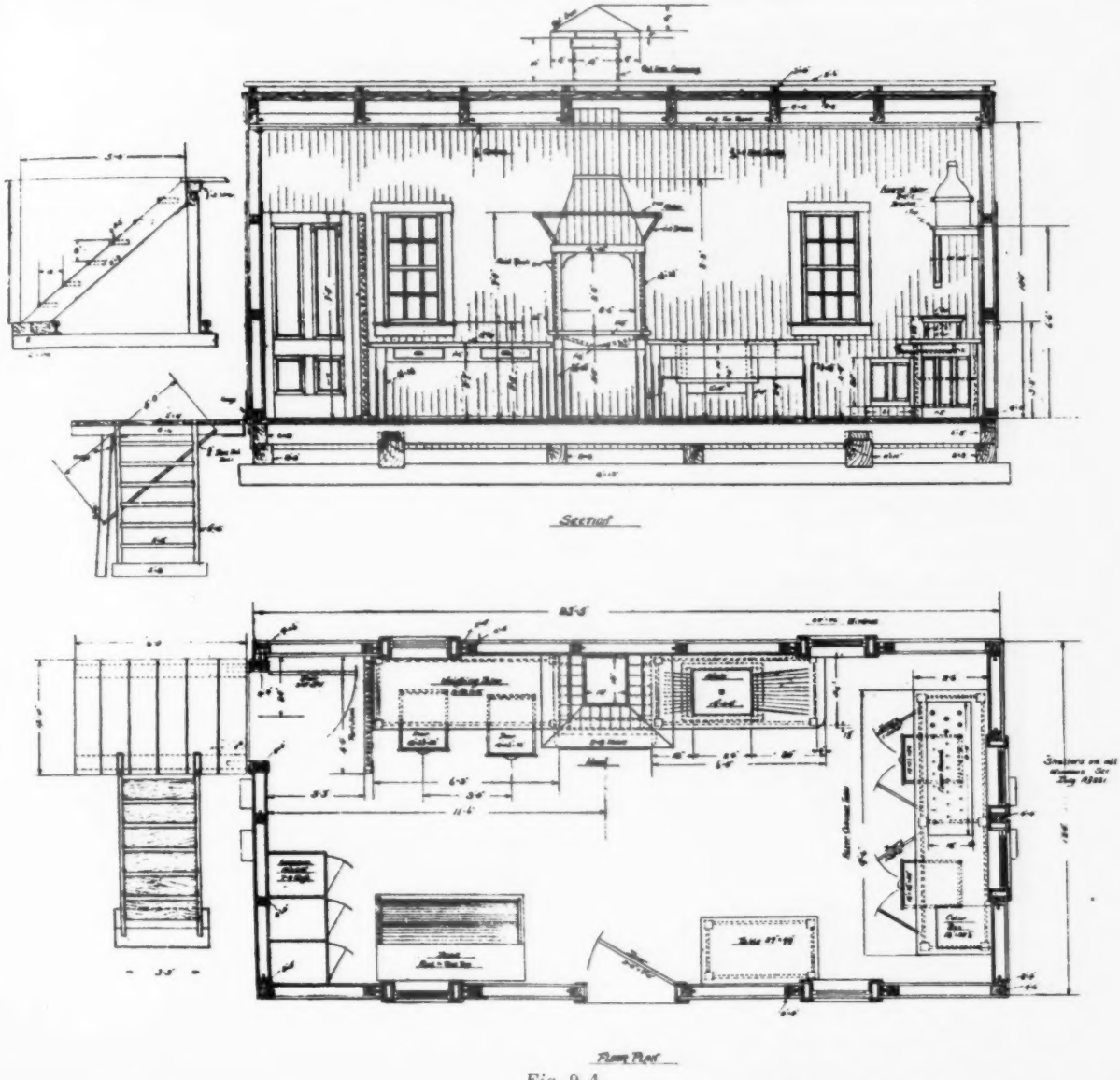


Fig. 9-A

Fig. 8

tabulated as to classes and location, which gives the final figures of material acutally mined.

The Table II gives the results of Hill and Mill sampling and assaying by months.

Figures 11 and 12 show the horizontal projections of the material as estimated and actually mined on the 5,240 bench. This illustrates the spotty and irregular nature of the ore occurrence, and one of the most important points considered in determining the method of mining.

A comparison of the figures shows that the "Expanded Estimate" for material above 1.00 percent copper has checked very closely with the results of actual mining to date. The results on material between .80 percent and 1.00 percent copper have considerably exceeded the expanded figures but this is not of such great consequence, as the schedules of operations and the question

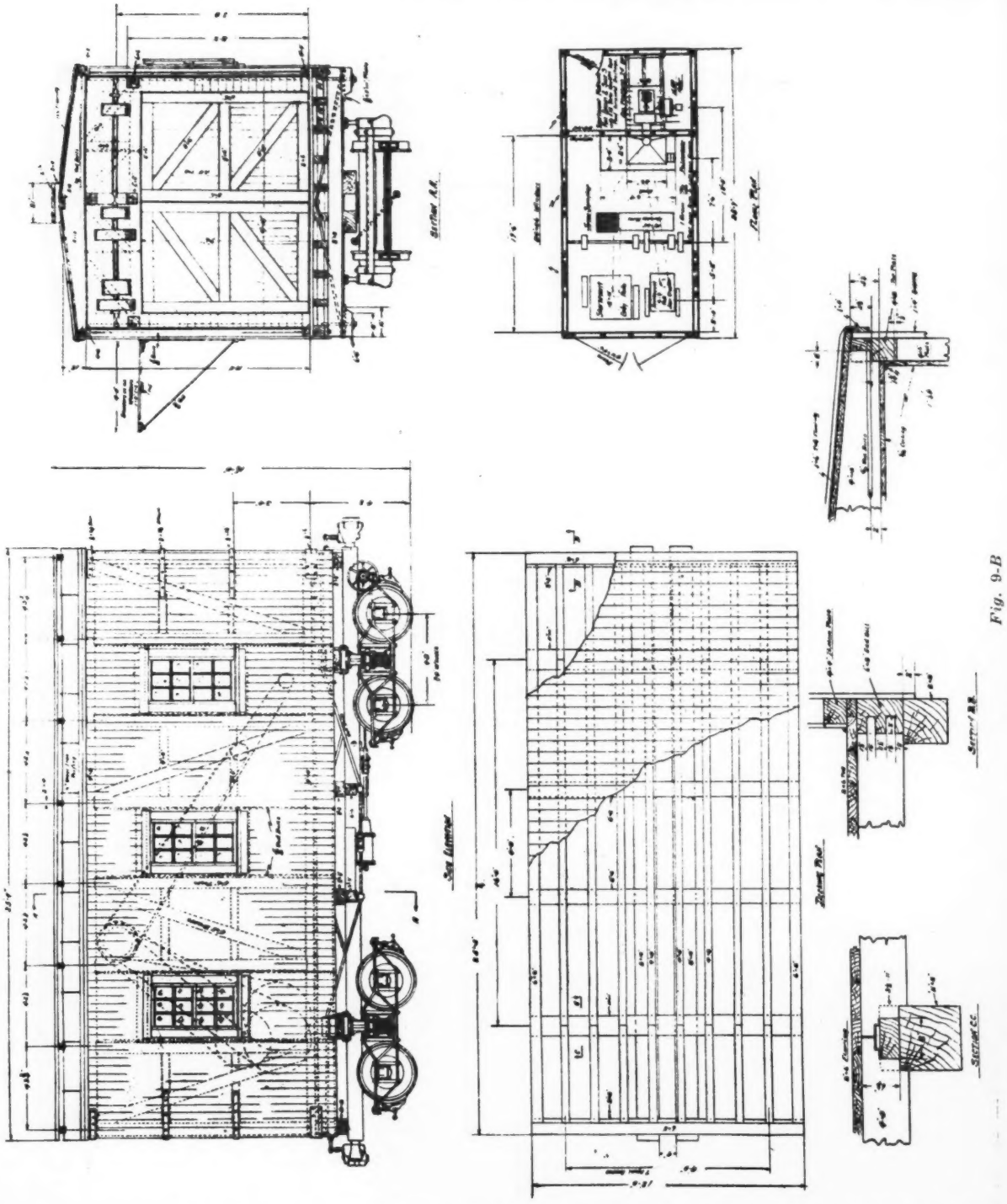


Fig. 9-B

of profits are governed largely by the material above 1.00 percent copper.

A comparison of material estimated and actually mined to January, 1924, is shown by the figures in Table III.

The two classes of material over 0.80 percent showed an increase in tonnage and copper contents over the original estimate. These differences were caused by one or a combination of three reasons: Namely, errors in sampling, errors in estimating, or mixing of one class of material with another during mining. It was noted that as mining progressed to where the ratio of ore to waste became greater, that the increase in tonnages and copper contents decreased. Obviously, steam shovels cannot mine right up to and along the theoretical lines of demarcation between ores of different classes used in calculating ore reserves. There must be some merging of classes when material is being loaded along a boundary. To get an accurate forecast of tonnages and grades as they will be mined, therefore, calls for a modification of the bench estimates. These base figures were therefore "expanded" as follows:

Above the 5,270 elevation both classes of material were increased by the same percentage of increase as had occurred during 1922 and 1923, as all work up to

Table III

	Material over 1.00%			Material 0.80 to 1.00%		
To January, 1922	Tons	% Cu.	Gross Cu.	Tons	% Cu.	Gross Cu.
Estimated	190,615	1.97	7,510,231	33,136	0.86	569,939
Mined	306,766	1.97	12,086,580	319,808	0.82	5,244,851
Over or under estimate	+116,151	0.00	+4,576,349	+286,672	—0.04	+4,674,912
% Over or under estimate	+ 60.9%	....	+ 60.9%	+865.0%	—4.65	+ 820.0%
Year 1922 and 1923						
Estimated	552,067	2.37	26,167,975	116,920	0.83	1,940,870
Mined	752,549	1.98	29,800,940	341,188	0.85	5,800,196
Over or under estimate	+200,482	—0.39	+3,632,965	+224,268	+0.02	+3,859,326
% Over or under estimate	+ 36.3%	—16.50	+ 13.9%	+191.0%	+2.41	+ 199.0%
To January, 1924						
Estimated	742,682	2.27	33,717,763	150,056	0.84	2,520,941
Mined	1,059,315	1.98	41,948,874	660,996	0.84	11,104,732
Over or under estimate	+316,633	—0.29	+8,231,111	+510,940	0.00	+8,583,791
% Over or under estimate	+ 42.6%	—10.09	+ 24.4%	+341.0%	....	+ 340.0%

Table V

Bench	1.00% and Above Tons	% Cu.	Gross Cu.	0.80% to 1.00% Tons	% Cu.	Gross Cu.
5360 and above—						
Estimated	.....	....	.....	.....	....	.....
Mined	60,523	1.66	2,006,812	268,595	0.82	4,417,716
5315—						
Estimated	284,191	1.55	8,834,361	55,230	0.83	919,690
Est. expanded	364,500	1.30	10,071,172	160,719	0.86	2,749,873
% Expansion	+ 36.0%	—16.1	+ 14.0%	+191.0%	+3.62	+ 199.0%
Mined	478,222	1.57	15,059,371	211,162	0.86	3,631,986
% Over or Under Est.	+ 68.3%	+1.29	+ 70.5%	+282.3%	+3.62	+ 294.9%
% Over or Under Est. Exp.	+ 23.7%	+20.8	+ 49.5%	+ 31.4%	....	+ 32.1%
5270—						
Estimated	796,933	2.04	32,498,928	89,219	0.80	1,403,950
Est. Expanded	1,083,829	1.71	37,048,778	259,627	0.81	4,197,811
% Expansion	+ 36.0%	—16.2	+ 14.0%	+191.0%	+1.25	+ 199.0%
Mined	1,061,220	1.80	38,187,316	517,691	0.86	8,893,732
% Over or Under Est.	+ 33.2%	—11.8	+ 17.5%	+480.2%	+7.50	+ 633.5%
% Over or Under Est. Exp.	— 2.1%	+5.25	+ 3.1%	+ 99.4%	+6.17	+ 111.9%
5240—						
Estimated	807,249	2.13	34,348,360	218,227	0.85	3,693,274
Estimated Expanded	934,873	1.95	36,460,784	475,037	0.87	8,221,597
% Expansion	+ 15.8%	—8.45	+ 6.2%	+117.7%	+2.36	+ 122.6%
Mined	944,996	1.90	35,915,034	435,704	0.86	7,495,733
% Over or Under Est.	+ 17.1%	—11.7	+ 4.6%	+ 99.7%	+1.18	+ 103.0%
% Over or Under Est. Exp.	+ 1.1%	—2.56	— 1.5%	— 8.3%	—1.15	— 8.8%
5210—						
Estimated	773,759	2.03	31,379,022	209,985	0.83	3,320,272
Estimated Expanded	883,091	1.87	33,101,730	407,444	0.85	6,860,539
% Expansion	+ 14.1%	—7.88	+ 5.5%	+101.4%	+2.41	+ 106.6%
Mined	834,446	2.02	33,658,827	389,138	0.86	6,684,489
% Over or Under Est.	+ 7.8%	—0.49	+ 7.3%	+ 93.6%	+3.62	+ 101.3%
% Over or Under Est. Exp.	— 5.5%	+8.02	+ 1.7%	— 4.5%	+1.20	— 2.6%
Total—						
Estimated	2,662,130	2.01	107,060,671	563,661	0.83	9,337,186
Est. Expanded	3,288,293	1.77	116,682,464	1,300,127	0.85	22,029,820
% Expansion	+ 23.5%	—12.0	+ 8.9%	+130.6%	+2.41	+ 135.9%
Mined	3,379,407	1.85	124,827,360	1,822,290	0.85	31,123,656
% Over or Under Est.	+ 26.9%	—7.95	+ 16.6%	+223.3%	+2.41	+ 233.3%
% Over or Under Est. Exp.	+ 2.8%	+4.52	+ 7.0%	+ 40.2%	....	+ 41.3%

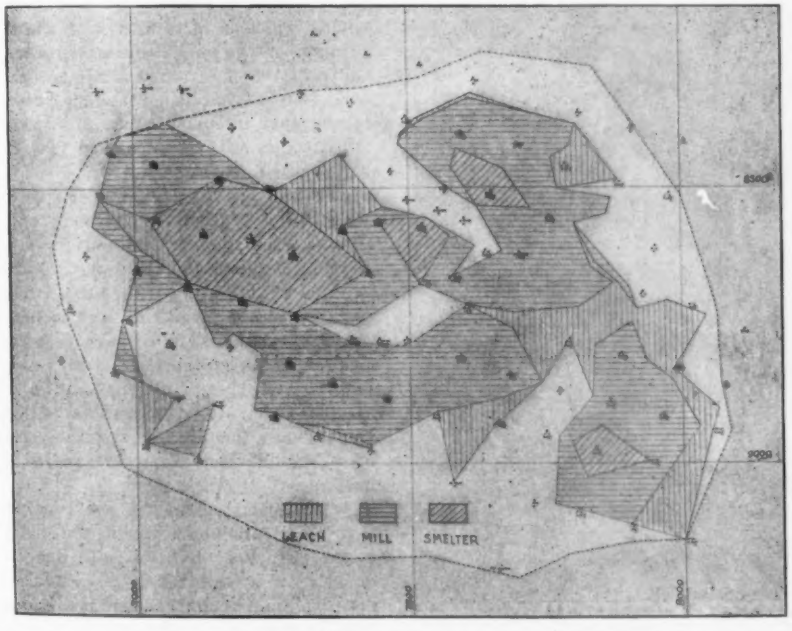


Fig. 11. *Intersections Of Estimated Ore*, 5240 *Bench*

Table IV

Bench	1.00% & above Tons	% Cu.	0.80%-1.00% Tons	% Cu.	Ore & Waste Tons
5540	.....	....	.....	....	624,453
5480	.....	....	.....	....	1,643,492
5420	.....	....	.....	....	2,817,279
5360	.....	....	.....	....	4,147,885
5315	386,500	1.30	160,719	0.86	4,064,811
5270	1,083,829	1.71	259,627	0.81	3,904,442
5240	936,164	1.94	465,151	0.86	2,306,822
5210	936,600	1.87	404,744	0.85	2,064,260

1924 had been done above that elevation, and it was assumed that actual mining would continue so. Below the 5,270 elevation where the ratio of ore to waste increased, the chances of increases of material over 0.80 percent copper over the original estimate would probably not be in the same ratio as above, as the chances of increases would have to take place in the lower grade materials, and as these became less as work progressed the percentage of increases in the material above 0.80 percent copper would necessarily have to decrease. It was, therefore, considered to be governed by the ore-waste ratios. It was assumed that the increases of the classes of material above 0.80 percent would be proportional to the ratio of that class of material to the remaining classes below that grade, and the ratio with which that class of material to that remaining below had been mined during 1922 and 1923. To illustrate, the 5,240 bench will be shown in detail.

During 1922 and 1923 the class of material above 1.00 percent copper was mined in the ratio of 1 to 4.25 to all other material below 1.00 percent; the material above 0.80 percent copper in the ratio of 1 to 2.11 to that below 0.80 percent copper. The material above 1.00 percent copper in the original estimate had a ratio of 1 to 1.86 to all below, and the material above 0.80 percent copper had a ratio of 1 to 1.25. 1.86 divided by 4.25 gives 44 percent and 1.25 divided by 2.11 gives 60 percent. The mining of material over 1.00 percent copper during 1922 and 1923 showed a 36.3 percent increase in tonnage and 13.9 percent in gross copper. Taking 44 percent of these increased percentages gives the factors used in expanding the original estimate—namely, 44 percent of 36.3 percent and 13.9 percent gave 15.97 percent increase to apply against the tonnage and 6.12 percent against the gross copper. Eight hundred seven thousand two hundred forty-seven (original tonnage) times 115.97 equals 936,164 (expanded tonnage). Thirty-four million three hundred forty-eight thousand three hundred fifty-five (original gross copper) times 106.12 equals 36,450,474 (expanded gross copper). The material above 0.80 percent followed the same method of figuring.

Applying the above assumptions to the original churn drill estimate, an expanded estimate was derived. The ex-

PHELPS DODGE CORPORATION
COPPER QUEEN BRANCH – SACRAMENTO HILL

SAMPLE REPORT

SHOVEL NO._____ SHIFT NO._____ 192__

TIME	ENGINE	EQUIP. CARS	WASTE				WASTE NO. 2				WASTE NO. 1				ORE			
			CARS	SAMP. NO.	ASSAY	ASSAY CARS	CARS	SAMP. NO.	ASSAY	ASSAY CARS	CARS	SAMP. NO.	ASSAY	ASSAY CARS	CARS	SAMP. NO.	ASSAY	ASSAY CARS
TOTAL																		

LOCATION OF SHOVEL_____

_____ SAMPLER

_____ ASSAYER

Fig. 10

panded estimate above the 5,210 is shown in Table IV.

A comparison between the estimates and results of mining up to January 1, 1926, above the 5,210 bench (all work completed) are shown in Table V.

A comparison of the figures shows that the "Expanded Estimate" for material above 1.00 percent copper has checked very closely with the results of actual mining to date. The results on material between .80 percent and 1.00 percent copper have considerably exceeded the expanded figures but this is not of such great consequence, as the schedules of operations and the question of profits are governed largely by the material above 1.00 percent copper.

Fig. 12. *Outlines Of Actual Ore Mined,* 5,240 *Bench*

COMBUSTION OF FUEL OIL

IN THE course of the fuel economy survey made by the Bureau of Mines in Government power plants, studies and tests have been made of various oil-burning equipments under power-plant boilers. There are now many types of burners being offered in the relatively limited field of power-plant use. The majority of the types used may be grouped into two general classes—those using steam to effect the atomizing of the oil and those using mechanical means.

Copies of Serial 2730, "Experiences with the Combustion of Fuel Oil in Power Plant Boilers," may be obtained from the Bureau of Mines, Department of Commerce, Washington, D. C.

PROSPECTING BY RADIO

(*Continued from page* 649)

a closed circuit to the receiver, where the tone pitch of the sound varies according to the mineral, metal or substance at the far terminal of the wave. Metallic substances produce a much higher tone pitch than any other mineral, and recognizable variations in tone are produced by all different minerals. These tones might be described as radio echoes, although they are not so technically. This expression, however, is very expressive of the effect produced, each mineral producing its peculiar echo.

The photographic unit of the radio cameraphone is fitted with a vibratory illuminated thin metallic foil about one inch square, suspended by a fine hair spring which is in contact with the diaphragm of the telephone mechanism in the radio receiver. The illumination of this foil if reflected in a magnifying mirror that intensifies it 30 to 40 times, so that the most infinitessimal vibration is projected from the mirror.

The reflected light of the foil in the magnifying mirror is thrown on a ground glass screen, the vibrations appearing as lights and shadows, and these are photographed by a regular motion picture camera, which is automatically exposed. One picture is taken with each foot of advancement in the radio wave length, and the photographic film developed from these exposures by the camera may then be thrown on a screen by a regular motion picture projecting machine.

A peculiar feature of the result is that the strata appearing in the motion picture are not all horizontal, but frequently lie at varying angles. This is not explainable, but shows the utmost sensitiveness of the device.

WATER TREATMENT AND UNDERGROUND LEACHING AT BISBEE MINES OF CALUMET AND ARIZONA MINING COMPANY

Disadvantages Of Lime Neutralization—Equipment For Air Agitation With Metallic Scrap—Cost Of Equipment—Results Obtained—No Replacement Or Repairs—Estimated Cost Of Copper Without Fixed Charges

By H. L. LAVENDER*

THIS subject will be considreed under two headings.

1. The treatment of acid and copper water of a corrosive nature, with the twofold object in view of first, protection of pumping equipment; second, recovery of copper content and elimination of lime treatment.

2. Leaching of old stope and fire areas, where the recovery of the copper content by mining methods is deemed to be impracticable, with the subsequent precipitation of the copper on scrap metal in underground plants.

WATER TREATMENT PLANT

With the sinking of the Junction Shaft of the C. & A. Mining Company and the development of the adjacent ground, the Junction pumping installation gradually came into the position of a central pumping plant for the lower end of the Bisbee district, draining not only the other shafts of the C. & A. Mining Company, but also a portion of the Copper Queen water from the Sacramento Shaft territory.

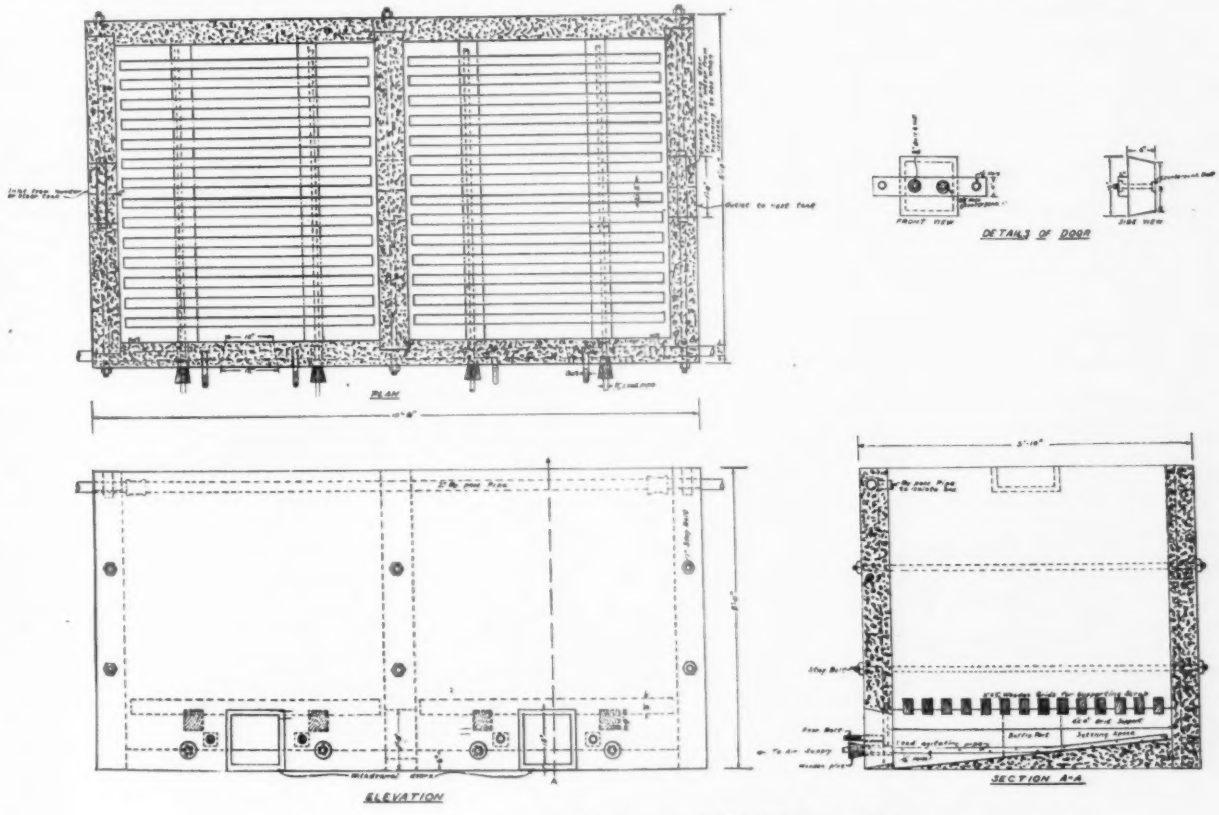
Part of this water being of a corrosive nature required special treatment to neutralize, in order to give protection to the pumping equipment being used. This, prior to September, 1925, was accomplished by means of a solution of slacked lime, the same being added directly to the water from agitating tanks. The disadvantages of the above method were as follows:

1. Cost of lime.
2. Loss of copper content.
3. Lack of regulation (flow of water varied from 98 G. P. M. to 452 G. P. M., copper content from 68 p. p. m. to 1800 p. p. m.).

This made necessary the use at all times of a large excess of lime, in order to take care of the irregularities of flow and corrosive content.

4. Frequent cleaning of sumps and ditches, due to uncombined and unslacked lime and the precipitation of the iron and copper contents. Preliminary tests were conducted which indicated the possibility of precipitation on metallic scrap, with the elimination of the lime treatment and recovery of the copper contents. In conducting these tests the use of the ordinary gravity flow boxes was found to be unsatisfactory. Owing to the relatively low copper content and the large flow of water (when maximum was reached) the room available underground was not sufficient without undue expense in enlarging to war-

* Chief Engineer, Calumet & Arizona Mining Co., Warren, Ariz.



C. & A. MINING CO.
DETAILS OF
AIR AGITATED PRECIPITATION BOXES

rant an installation of that type. The water as delivered to the boxes also contained a large amount of suspended matter, mainly water silica, the finely divided sulphates of lime and magnesium and iron hydrate which settled out in the tanks and not only lowered the grade of precipitate produced, but coated the surface of the scrap with a protective coating which greatly diminished the neutralizing action of the same, making the lessening of the corrosive action to a safe point, a matter of considerable doubt.

Owing to the above consideration it was decided to use air for agitation in connection with the use of the metallic scrap. The details of construction of the type boxes used are as follows:

1. Water-proofed concrete boxes, 10 feet long, five feet wide and five feet high. Each unit consists of two compartments five feet by five feet by five feet.

2. A wooden tray or grid placed one foot above bottom, for support of scrap iron.

3. Three-quarters inch lead pipes, with one-sixteenth inch holes, staggered at six inch intervals, introduced through wooden plugs beneath grid. The plugs were tapered to permit easy withdrawal for cleaning purposes.

4. A root positive blower, operating at three pounds pressure which supplied air through a six inch line to the lead pipes, each box being supplied with four of the same. Blower operating at 680 cu. feet per minute.

5. A withdrawal door 12 inches by 12 inches, beveled into the side of the box, beneath the wooden grid. The removal of the door permitted the precipitated copper to be flushed directly into a launder, from where it was shoveled into cars.

The advantages of the above method in connection with this water were as follows:

Successful treatment of water which had previously been a waste product.

High extraction and almost complete neutralization.

Greatly increased capacity per unit of space.

Higher grade of concentrate. An average of 60 percent Cu against 12 percent by gravity method in connection with this water.

Elimination of labor. Scrap iron is added at top and withdrawn as precipitate by flushing, no further handling or cleaning being necessary.

The following figures are the result of the first eight months' operation of the plant, September 1, 1925, to May 1, 1926:

Smelter Returns on Precipitate Shipped

123.33 wet tons precipitate, 26.56 percent H_2O. 90.50 dry tons, averaged 61.13 percent Cu, a total of 110,656 pounds Cu.

Total operating cost for the above period, includes labor, power, material and all other charges, $6,182.45.

Cost of copper, 5.59 cents per pound.

Segregration of Charges

Total iron used during the same period, 169,700 pounds, or 1.53 pounds per pound of copper produced. Iron costs 0.90 cents per pound (detined, baled scrap).

	Cents
Iron cost per pound of copper	1.377
Labor, including handling of all materials	1.879
Power	0.666
Assaying	0.337
Misc. Shop, Lighting, Tramming, etc.	1.331
Total	5.59

The above figure does not include depreciation or interest. To date there have been no replacements or repairs.

REFINED COPPER COST

	Per Pound
Copper delivered to collar shaft	5.59c
Freight to smelter—smelting	0.59c
Refining, brokerage, freight—Atlantic Seaboard	2.20c
Total	8.38c
Profit from sale of copper @ 14c	$6,218.87
Saving on elimination of lime treatment for the same period—8 months @ $341.00 per month	2,728.00
Total	$8,946 87

INSTALLATION COSTS

Widening 110 feet drift, guniting the same	$962.59
Blower, pipes, electric wiring, etc.	1,100.00
Concrete construction of boxes	2,896.57
Total	$4,959.16
Average flow of water to tanks	172 g. p. m.
Average copper content of heads	228 p. p. m.
Average copper content of tails	8 p. p. m.
Recovery	220 p. p. m.
	96.4%

AVERAGE ANALYSIS—Filtered Sample

	Parts per Million Heads	Tails
Acidity	30.96	2.84
Fe_2	971.00	1225.00
Fe_3	95.00	Trace
Cu	228.00	8.00
SiO_2	50.00	
CaO	590.00	
MgO	539.00	
So_3	4169.00	
Al	53.20	
Mn	379.00	
Cl	12.55	
	7177.71	

PLANT CAPACITY

Ten boxes in series. Each box 10 feet by five feet by five feet, a total of 2,000 cubic feet of iron capacity.

Air for agitation, calculated at one cubic foot per square foot of surface at three pounds pressure.

Maximum 24-hour load under which boxes have operated, 1800 p. p. m. Cu.

268 G. P. M. equivalent to production of 5780 pounds per day.

Equivalent to 2.89 pounds Cu, cubic feet of iron space, per 24-hour day.

This was accomplished with no increase in copper content of tails.

Eighty percent of all copper is collected in first three boxes of the installation, the last boxes in series being cleaned at very infrequent intervals.

All water measurements were by the Lea-V-Notch recorder. Three 53 degree V lead weirs were used.

Samples were of each 24 run, by automatic samplers.

Leaching of Briggs Fire Area

In 1920, a large sulphide stope country of the Briggs Mine caught on fire. All attempts to extinguish the same being unsuccessful, it was necessary to isolate the entire area by bulk-heading and in addition to sink a ventilation shaft to provide an outlet for the resulting gases. By these measures it was possible to resume mining in the surrounding territory.

Within the fire zone, there remained several sections of smelter ore and a considerable area of low grade sulphide. Attempts to mine these areas have not been successful, due to a number of causes, among which might be mentioned; exceptionally high temperatures, gaseous conditions, further fire hazard and the caved and broken up character of the ground. All supporting timber had been destroyed and as several large sections were working and had not been filled at the time of fire, this gave an opportunity for extensive ground movement, not only within the stope area proper, but extending over into the adjoining low grade sections.

In attempting to control the fire, by flooding, it was observed that the run-off water contained a large amount of copper in solution. All efforts at mining, having given unsatisfactory results, it was decided to attempt to recover a part of the copper by leaching operations and subsequent precipitation underground. The ore within the fire zone was estimated at 79,556 tons; 4.292 percent Cu, containing 6,830,000 pounds Cu. This does not include the low grade area, of which a large tonnage exists.

In December, 1925, the construction of a precipitation unit was started on the 1500-foot station of the Briggs Mine. One side of the station was used and three boxes, identical in type with those described in the article on water treatment, were erected. The iron capacity of the three boxes is 600 cu. feet. These are supplied by a 366 cu. ft. blower. One-half of the air in this case being used for agitation, the rest by passing to atmosphere. The latter portion will be available for any plant addition that may be necessary.

The nature of the ore-body, within the fire zone, was of a flat deposit of from 40 feet to 60 feet in thickness, various blocks occurring from just above the 1,400-foot sill to a point about 60 feet above the 1,300-foot level. As all of the mining operations were of the square set or slice method, requiring waste filling as each section was mined, raises were run from the top of each for gobbing purposes. Practically no ore was found on the 1,200-foot level immediately above this area, so that the drifting there was mostly all run to afford filling facil-

ities and also to aid in the handling of timber to the stopes below.

Under the stope area were crosscuts, both on the 1,400-foot and the 1,500-foot levels, from which extraction raises had been driven to the bottom of the various blocks of ore.

The tentative plans called for the introduction of the leaching water on the 1,200-foot level through the series of fill raises and the collection of the resulting water on the 1,400-foot and the 1,500-foot levels by means of concrete dams in the crosscuts. From that point the copper water was to be handled to the precipitation boxes by means of wooden launders on the 1,500-foot level and to the shaft in concrete ditches on the 1,400-foot level, and down the shaft to the installation by means of lead pipes. The bulkheads, on the 1,200-foot level, were first opened and disclosed an extremely heated condition. After remaining open for a short period of time, they cooled sufficiently to allow the introduction of pipe lines. The water was derived from two sources, namely:

1. Drainage water from the Cole and outlaying Briggs area. This water formerly was directed through to the Junction pumps. It is now pumped directly into the fire area.

2. Water from the 1,500-foot level bulkhead, is delivered to the 1,200-foot level under its own hydraulic head and diverted to fire area by an air operated Duplex pump. The combined water to the fire area averages about 120 G. P. M.

Water for leaching was first applied in January, 1926. At first, an attempt was made to distribute the water over alternate sections covering a large territory. After a considerable period of time, no water having shown on the lower levels, due no doubt to the exceeding dryness and high temperature within the fire zone, all water available was concentrated in a small area. This step was first taken in April of this year. During the month of June, a slight amount of water began to appear on the 1,400-foot level, almost 200 feet directly below the point of application. By drilling through the bulkheads on this level the flow gradually increased to a maximum of 4 G. P. M. The rest of the water being lost in soaking up the country and evaporation. The temperature of the issuing water on the 1,400-foot level as of August the 6th, after falling several feet, was 153 degrees F. The percentage of water recovery has been to date about 3.33 percent. The copper content of the water varying from 18,000 p. p. m. to 3,600 p. p. m., with 8,000 p. p. m. as a fair average. In terms of pounds of copper per thousand gallons the variation would be from 30 pounds to 150 pounds per thousand gallons.

ESTIMATED COST OF COPPER—FROM THE BRIGGS FIRE AREA

Present Plant Capacity Estimated at 2,000 Pounds per Day

Pumping	No charge
Labor—2 shifts at $5.25	0.525c
Iron	1.377c
Air	0.070c
Assaying	0.070c
Lights, sundries, shop, etc.	0.700c
Total per pound of copper	2.742c pound
Charges for smelting, refining, etc.	2.79c pound
*Cost refined copper per pound	5.532c

*Includes no fixed charges.

TOTAL COST OF WORK DONE IN CONNECTION WITH LEACHING OPERATIONS AT THE BRIGGS MINE TO AUG. 1, 1926

Labor—Miners, timbermen, muckers, etc.	$2,528.14
Shop labor	977.47
Blower	587.20
Pipe and fittings	107.32
General supplies—cement, sand, scrap iron, etc.	531.50
Lumber—timber	133.33
Miscellaneous—oils, grease	312.95
New 250-gallon pump, complete with motor, pipe lines, etc.	3,032.00
	$8,209.91
August expense—estimated	450.00
Estimated total expense to Sept. 1	$8,659.90

It was apparent that the problem was one of an adequate water supply until such a time as sufficient cooling of the ore body would be obtained to lower the resulting evaporation and saturating loss. Accordingly, there was planned a 250 G. P. M. centrifugal pump installation, to pump against a 500-foot head, the motor requirements being nominally 60 h. p.

The water to be directed to the fire area is seepage and run off water from the lower Briggs Mine levels. This water normally goes to the Junction pumps by the 1,500-foot Briggs Stations, so that the pumping plant could be placed at that point in connection with the Precipitation Plant.

The pumping cost is estimated at 5 cents per thousand gallons. But in this case the figure is misleading, as the water pumped to leaching operations would otherwise be pumped to the surface from the 2,200 level of the Junction Mine, at a cost of approximately 14 cents per 1,000 gallons. Thus any evaporation would afford a direct saving of 9 cents per 1,000 gallons. In other words, up to a point where in excess of 60 percent of the water introduced was returned to the Precipitation Plant, the pumping would be at a distinct saving. In view of the experience of the past seven months the recovery of water should not approach that figure for a very considerable period of time, as there has been a distinct increase in the temperature of the water issuing since start of operations.

An average assay of the water to the Precipitation Plant follows:

	Parts per Million	
	Heads	Tails
Ac.	489	3.09
Fe_2	15,708	23,616
Fe_3	476	Trace
Cu.	7,400	Trace

The extraction, as will be noticed, is practically complete, as in none of the tails solutions has more than a trace been detected. In the assay for copper anything below 5 p. p. m. is reported as a trace; above that at its respective strength, so that in this case the tails contained at no time more than 1/2,000 of 1 percent Cu, the improvement in extraction over the water treating plant being due to the lack of contaminating influences.

At an average of 8,000 parts Cu per million, or 66 pounds per thousand gallons, the plant over the last few weeks has averaged about 380 pounds per day. Ninety percent of this copper has been collected in the first of the three units. The third unit has not been cleaned to date, while the second has been cleaned once and a very inconsiderable amount of low grade copper was obtained in this instance. The average grade of copper obtained to date has been in excess of 73 percent Cu.

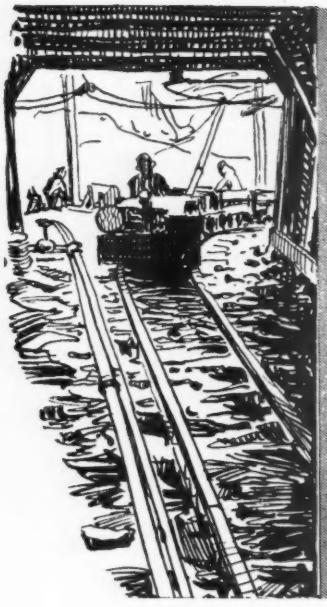
From the experience to date the following figures of the cost of copper produced at an estimate plant capacity of 2,000 pounds Cu per day are offered.

COAL MINE FATALITIES IN JUNE

ACCIDENTS at coal mines in the United States in June were responsible for the loss of 145 lives, according to information received from state mine inspectors by the Bureau of Mines, Department of Commerce. Of this number 105 deaths occurred in the bituminous mines and 40 in anthracite mines. Based on a production of 41,992,000 tons of bituminous coal and 8,937,000 tons of anthracite, the fatality rates per million tons of coal produced were 2.50 and 4.48, respectively, while for the industry as a whole the rate was 2.85. Based on a production of 37,167,000 tons of bituminous, 7,576,000 tons of anthracite, and 44,743,000 tons of bituminous and anthracite, the fatality rates for June, 1925 were 2.88, 7.00 and 3.58, respectively.

HARRINGTON APPOINTED CHIEF ENGINEER OF SAFETY SERVICE

DANIEL HARRINGTON, of Salt Lake City, Utah, has been appointed chief engineer of the Safety Service Division of the Bureau of Mines. Mr. Harrington served as a mining engineer of the Bureau of Mines during the period 1910 to 1924. In 1924 he resigned and opened a consulting mining engineer's office in Salt Lake City. During his former connection with the Bureau of Mines, Mr. Harrington made a special study of health problems of workers in metal mines, giving particular attention to dust and ventilation problems.



COAL

PRACTICAL OPERATING MEN'S DEPARTMENT

NEWELL G. ALFORD, Editor

Practical Operating Problems of the Coal Mining Industry

EFFICIENT ORGANIZATION IN THE COAL INDUSTRY

Efficient Organization Rests Primarily With The Mine Manager; If He Learns The Importance Of Delegating Both Authority And Responsibility, If He Adopts Steadfast Rules And Enforces Them, At The End Of The Year His Report Will Show Profits In Place Of Explanations

By W. M. WILEY*

IN SUCCESSFUL concerns there is usually one man who manages the business. Neither his title nor his nominal authority is important. He may be the chairman of the board, the president, the vice president, the general manager, the manager, the superintendent, a director, or a stockholder, but usually one man gives the policy and directs the operations.

The terms "manager," "superintendent," and "foreman" are used here to show relative degrees of authority and responsibility. The man referred to as "manager" is meant to be the one who actually directs. His title may be chairman of the board or bookkeeper.

One problem which constantly confronts an executive is to determine who is at fault for the little mistakes which occur in an ordinary business day. The bigger problem of who is at fault for the failure of a department follows, and while the second problem is more important to the success of the business, the causes of both failures are the same.

It has been the habit in some concerns to permit each subordinate to find reasons why everyone is to blame for any given error but himself. By a more or less subtle line of reasoning, the responsibility is passed until eventually the office boy is accused, and he, lacking the ability for subtle reasoning and lacking experience in dodging responsibility, is held to blame.

Today there is a reversal of this view. As a matter of fact when an error occurs, the stockholders are to blame. Whether they accept the blame or not, the cost of the error comes out of their pockets. They appoint a board of directors to whom is given the authority and who should assume therewith the responsibility. The directors in turn appoint a manager to whom in a degree the responsibility and the authority pass. The manager appoints a superintendent, the superintendent appoints his foreman, and the foreman selects his men, and in each case sufficient authority passes to equal the responsibility with which each man is charged.

An evidence of wisdom is a desire to learn. The bigger an executive, the more certain he is that other men know something. Men can be so treated that even if their ideas and suggestions for the betterment of the business are not accepted, they will keep thinking and suggesting. Out of fifty suggestions, one good one may pay for all the trouble. The man with a suggestion must be studied carefully and his motive determined.

By this method instead of the responsibility for any error attaching to the employe with the least experience and receiving the smallest compensation, it attaches to that employe who has the most experience and is paid the greatest compensation, and the manager should be made to realize that his ability to prevent errors and mistakes and to produce results is the measure of his worth.

It is the manager who must determine the purpose of each factor of the organization. It is he who must define the authority of each superintendent, and keep the authority of two superintendents from lapping. It is he who must place the authority so that no superintendent can dodge it. It is he who must lay down the law regarding the system of rewards and punishments and then personally see that they are followed by each superintendent. It is he who must develop the ideals in his superintendents and then see that the superintendents develop them in their men. It is he who must know that there is a reason why each motion is made at the expense of the stockholders (because all motions in business cost money) other than that the habit of incurring this expense yesterday

* Vice-President, Boone County Coal Corporation, Sharples, W. Va.

caused it to be incurred today. It is he who must control his temper and his emotions and show his superintendents how to administer discipline without personal feeling—to show that his appreciation of men is based on their value to the business, and not on his personal feeling of like or dislike for them.

These are only a few samples of a manager's duties and responsibilities. The fact is that unless he has been robbed by the board of directors of his authority he is responsible for all erorrs and for all successes. "Robbed of his authority" may be considered too strong a term, because no board of directors would do so foolish a thing. As a matter of fact, it occurs every day, and it is done so easily and in such a matter of course way that the director, president or important stockholder, who requests that employment be given to a friend or relative, actually does not realize that the manager is being robbed of his authority and of his ability to serve his company.

The salary which such a friend or relative receives is the least of his cost. His first cost to the business is that he feels that the manager can not discharge him. He does not have to use his brains learning the manager's policy, nor must he use his time working out that policy. His excuses must be accepted. He can deliver conversation in the place of results, and because the manager can not hold him responsible for his acts the business committed to him falls down.

His second cost is the effect his employment has on other men. If one man can keep his job without producing results, why not others? The other employes seek by playing business politics (every manager will know what that means), by self-advertising, by securing a pull, in fact, by ways so numerous as to be astonishing, to stand well without either thinking or working.

The cost of such a man to a concern can not be computed.

The manager can not hold a superintendent responsible for results if there is one man in his department who does not consider the superintendent his boss and the arbiter of his fortunes.

Men will read about efficiency and scientific management and then actually take the working tools from their manager and superintendents whose efficiency counts most to them.

This fact is so apparent that it should need no elaboration to carry conviction.

Put it another way. A manager selects with great care a man to be superintendent. He selects a man who he thinks is especially good at managing men; then by refusing to give the superintendent the authority to appoint, discharge and discipline his men he ties his hands and prevents him from serving the business in his capacity as superintendent. He pays him from $1,500 to $4,000 a year and by his own act makes it impossible for the superintendent to return the value of more than $2 a day.

Nor do the effects stop here. The manager fools himself. He thinks he has a superintendent, and when things go wrong he fumes and complains because "he can't find good men"—"the men of today are not what they used to be," and such talk. The truth is that a superintendent has been created in name only; a straw boss has been created in fact, and it is not just to expect from a straw boss what a superintendent could give. The fault is with the manager.

In the business where the manager attempts to appoint the subordinates to the superintendents as well as his superintendents, the subordinates do not feel that they are responsible to the superintendent and keep their eyes on the big boss, so that he will be pleased with their work. The superintendent, lacking authority, instead of being able to discipline his men and draw out of them their best, and thereby perform the functions for which he is paid, does little else than keep the time of the employes in his department and acts as sort of a spy to report the shortcomings of his men to the man in authority.

Suppose such a business has 10 departments. The manager can be in only 1 out of the 10 at a time, and while the employes of that department are attending to business during his presence there is an indefinable but costly lack of attention in the other nine departments, whereas if the superintendent of a given department is responsible for the showing of his department and feels his responsibility keenly, and at the same time has the authority to acquit himself of that responsibility, each department has a real boss present all the working hours, and the results can not help but be commensurate.

In a proper organization an error occurring in one department brings the superintendent before the manager and places him directly before a fault for which he is responsible. If one of his men made it, he must admit himself to be either incapable of appointing good men, of training men to do their work properly, or of giving them proper supervision. Having been given the authority, he must take the responsibility, and one or two sessions with the manager will either produce that attention to his business necessary to get results or his resignation upon his own initiative will be forthcoming.

A title and a commensurate salary do not make a superintendent. It is the authority and the way he uses that authority which makes a real superintendent. A man's worth is not established because he is made president of a bank. He is thereby only given an opportunity to prove his worth. So the manager must teach his superintendents when they are promoted that the title and increased salary are matters of secondary importance. The real question before the manager and the superintendent is, Can the superintendent fill the job so as to be a credit to both himself and the manager?

Here we come to the very essence of discipline. The superintendent realizing that his advancement comes from merit and not from pull, also realizes that his further advancement will come from the showing of his department. The man with such an attitude will study his boss to learn his policy and methods, will constantly go to his boss for help in solving his problems, and the boss becomes a real boss, knowing all that goes on in the department without having to spy to learn. Once more the manager is responsible and this time for the attitude of his men. His responsibility seems never to cease.

A study of the lives of our great captains of industry shows their great feat to have been, first, picking good men; second, clothing them with authority; third, holding them personally responsible. By this means efficient lieutenants were developed. A manager has no more valuable quality than the ability to pick and develop good men.

In order that the manager should be held responsible, it is necessary that he should have the sole authority to appoint his superintendents or heads of departments. The superintendents in turn should have the authority to appoint their men.

This policy will be questioned because, while the manager will be credited with the ability to judge of men and make successful appointments of superintendents, the ability of the superintendents to appoint their foremen, and much more the ability of the foremen to select their men will be doubted.

This objection must be admitted as being a difficulty, but it is only one of the many difficulties which the manager, by his ability, must overcome. The manager can so treat with his superintendents that they will discuss with him the merits of different applicants for the position of foreman, and the manager can so arrange that, while the superintendent makes the appointment, it is done with the advice and the approval of the manager. So the superintendent is made responsible for his foreman, and, what is more important still, the foreman feels himself responsible to the superintendent and not to the manager.

At the same time the manager has succeeded in having the appointment made with the benefit of his best judgment.

This rule of business is not a hard and fast rule. The principle of the manager fastening personal responsibility on the men next to him and having them in turn fasten the responsibility upon their subordinates, must be considered as an ideal, keeping in mind always that the rule is in use for the benefit of the business, and the business is not operated to prove the rule. It has been said that no ideal worthy of the name is susceptible of attainment, but it is nevertheless necessary to have ideals; so it follows in business that while a rule such as that outlined above can not be lived to the letter, if it is accepted as an ideal we can all gradually work to that end.

While in the above, the relation of manager to superintendent is used as an example, it applies equally to the relation of the directors to the president; the president to the manager; and through the superintendents to the foremen.

Responsibility and authority go together. A man can not be held responsponsible unless he has the authority to properly acquit himself of his responsibility. A boss, whatever his relative rank, fails in his functions when, having given a man the authority, he neglects to hold him personally responsible for everything over which his authority reaches.

When a man is given authority the great difficulty is to get him to pass it. His inclination is to pass responsibility and keep the authority in his own hands. They are so self-centered that they think (a) passing authority to subordinates lessens their dignity, and (b) they think they owe it to the business to give their personal attention to every detail. As to (a) there is certainly more dignity attaching to the manager of a business, or the superintendent of a department, where things go with clocklike smoothness than where they seem to mix themselves up. As to (b), a man renders his business a higher grade of service in teaching men to use authority than by dwarfing their ability and using authority for them.

The real danger to this method in business, is, that in developing the responsibility of the superintendent by giving him authority, we are liable to develop that greatest of business disease, "swelled headedness" or exaggerated egotism. It is the manager's function to realize the dangers of this disease and to be so close to his men that they carry out the policy which he marks down for them, and that the desire to make a success in their department is so great as to counteract the tendency to "swelled headedness." This disease is produced by men accepting authority without realizing the responsibility. A proper realization of responsibility keeps a man's head from swelling, no matter how exalted his position. It is only when he fails to realize his responsibility that he is subject to the disease. A swelled-headed man will not learn. When a man stops learning, his usefulness ceases. The first step is to reduce the swelling. It is a question if there is a cure for the two twin diseases which cost business so much—swell-headedness and self-pity.

It is frequently the case that the man charged with the administration of a business, spends time at a desk that should be spent watching the use of authority which has been placed in the hands of subordinates.

A successful organizer once said, "It is the first duty of a manager to listen for, and remedy squeaks."

Another put it, "A manager should provide someone to care for all routine matters that can be foreseen. On arriving at his desk his time should be free to hear the problems of his superintendents and help to solve them. It is most important that the superintendents feel that the manager considers the help he can give his superintendents the most important of his duties and that they are encouraged to bring their problems to him. That manager who is too busy to give audience to his men soon finds that either things are not done, or that they are done improperly. He not only loses that intimate contact which enables him to know his men, but his departments soon cease to coordinate. His main job is to carry an oil can and see that each part of the human machine works smoothly—to see that "red tape" and system hamper nowhere. The day will never be long enough to make him sure that all parts are working equally smoothly."

It is impossible for a manager to know his subordinates too well. He must know his men so that he knows what they are doing when he is not present. He must know the attitude of a superintendent's mind so that discipline will be administered with justice and kindness, with the result that foremen give the superintendent, and the men the foremen, the best that is in them. The manager must keep so close to his superintendents that, instead of looking upon him as a spy from whom they hide their mistakes, they look upon him as a friend and adviser to whom they themselves bring their mistakes and ask for help and assistance. The superintendent should feel that his department has the benefit of the manager's brains as well as his own, and that he earns credit for a better showing than he could without such assistance.

When a boss succeeds in having his men obey his orders because they are orders, he has only opened the primer of discipline. It is only when he has built up such confidence in his men that they obey because they have learned he is right, and because his judgment and experience will help them to make the showing for which they are striving, that real discipline begins to develop. The men must consider the advice or suggestion of the boss golden. Golden because it increases the profits of his department and turns the efforts of the men into gold.

In times of business depression or of acute competition when every man of an organization is called on for his best to go up against the situation, the organization which obeys only, hits the trouble with a gentle divided force like water from a sprinkling pot; the organization which is welded together with common interest and common confidence hits with the cohension and force of a hydraulic giant.

Men can not be hired for so many dollars a day and then successfully driven with a prod. The best that a man has to give is earned by the attitude of his superiors and by their developing in him the desire to give that best. It is only when an employe is educated to the point that he realizes that the giving of his best today will enable him to give better tomorrow and that that best and better will be appreciated and that he himself is thereby made a greater earning factor for himself and his family, that the results in organization which really count, are produced.

Another problem constantly confronts the executive of almost all businesses which are growing, and that is the need of good men for good positions. The men who are educated in the management of things, are common. Men who are educated in electricity, structural steel, steam, machinery and almost any subject, can be found in quantities. What is constantly being sought is the man who can manage men. The great human nature element is as great, if not a greater factor in business today, with all of our scientific management, as it has ever been, and while in the selection of employes some men judge the real men under the surface better than others, all men make mistakes and they need to try out a man in a position of responsibility before they are certain that he can be trusted to make good in his management of men.

By the policy outlined above, the office boy will find that he can not dodge the responsibility of finding a letter that should have been filed in a certain place. When the filing system grows too large for one boy, he can be consulted with and his recommendation for another boy, to

assist him in his filing, considered. The office boy can begin to have his ability to manage a second boy developed at that age and as he is promoted with years from place to place, the weakness and strength of his character in managing his subordinates can be developed until the manager has not an impression of a character, but has a chart in his mind of the boy's strength and weakness. This chart of a man's ability can only be produced in the manager's mind by giving the boy an opportunity to do things and take the responsibility for doing them and then watching his method of assuming the responsibility and acquitting himself of it.

The time has passed for a one-man business. That man who can successfully manage a business no larger than that in which he can do all the work is not a manager. The ability to delegate responsibility and authority to other men and see that they properly do the work committed to them, is one of the measures of a manager.

One of the most important functions of a manager is to develop his men and to see that each man at the end of a given period is a better man than he was at the beginning of it—better in his ability to serve his employer, better in his ability to develop his subordinates, better in the development of his personal efficiency and therefore better for himself in that he has developed his own earning power and his own value.

In an un-to-date business, it is considered a reflection on the management to discharge a man, unless necessary to reduce expenses. Men are employed with great care. Then it is the duty of the boss to develop them and make them valuable. In event of a failure, the boss has his share of responsibility. If he had been a better trainer, a better teacher, a better judge of men, the man might have been valuable to both the concern and himself. Sometimes the carelessness with which an organization is put together causes the man's failure. The boss immediately over him, whether superintendent or foreman, knows his work, but lacks the authority to discipline him. The real boss, the man with authority, is so far removed he can not know the man's failings and lack of interest in his work. Having no ideals, the man laughs at the impotence of the straw boss and takes an absolute joy in the game of fooling the real boss. The entire force in a shop will catch this attitude like they would the measles and all join in the game; at first for the fun of it; soon from meanness. This meanness has been cultivated by the management.

When subordinates are clothed with authority, one danger is that they are liable to drift away from their superiors; another danger is that they may not use their authority properly. The tendency in both cases is guarded against by the boss keeping in such close contact with his superintendents, foremen and men, that he senses their point of view. This should be done and can be done in such a delicate way that the manager knows the feeling between the sub-bosses and the men. When friction is indicated, he will through the sub-bosses, not directly with the men, cure the trouble before it becomes serious.

It is a tendency of human nature, in the rush and drive of present-day business, for the manager, when he sees something wrong in the department of a superintendent, to remedy the wrong and feel that he has performed his duty. When the manager personally remedies the mistake, the superintendent is left uneducated to the extent that learning how to do that particular thing would have educated him. While the mistake itself may have been remedied, the superintendent is not made to learn how by doing it himself. You can't show a man how to swim. He learns by practice.

Men can not be hired for so many dollars a day and then successfully driven with a prod. The best that a man has to give is earned by the attitude of his superiors and by their developing in him the desire to give that best. It is only when an employe is educated to the realization that the giving of his best today will enable him to give better tomorrow and that that best and better will be appreciated and he himself thereby made a greater earning factor for himself and his family, that the results in organization which really count, are produced.

There are many valuable ideas in the heads of subordinates which an executive can get with a proper policy. No man knows it all. An evidence of wisdom is a desire to learn. The bigger an executive, the more certain he is that other men know something. Men can be so treated that even if their ideas and suggestions for the betterment of the business are not accepted, they will keep thinking and suggesting. Out of 50 suggestions, one good one may pay for all the trouble. The man with a suggestion must be studied carefully and his motive determined. Does he want to make a showing at the expense of other departments? Is he trying to salve his wounded dignity? Is he submitting some superficial plan in order to make himself prominent? Or is he honest in his avowal of wanting to help the business? Suppose the latter. The boss has two ways of treating him. He can raise his weary eyes from the routine before him, visibly assume his cloak of patience, rap his pencil on the desk, and looking into the deep distance beyond the man, tell him when he has finished that he can see nothing to the matter. The man who started the talk with enthusiasm and punch, gradually slows down until at the end of his statement his words can hardly be heard. When he leaves, his lesson is learned and no matter what he thinks in future, he will remember to mind his own business.

On the other hand, the boss can say, "All right, Jones, sit down. There are no doubt many things which can be improved. Go to it, and tell me all about it." Talking back at him and arguing against the man's views, the boss develops the ability of the man to think and plan and his sureness of himself and his confidence in his own judgment. Care must be taken to have the man understand why his suggestion is not accepted. At the conclusion of the interview, the man leaves closer to the boss than before and anxious to submit a new plan which may be approved.

The policy of giving men authority and holding them responsible would help to solve two of the great problems which confront every manager. First, to have someone personally responsible for whatever goes wrong and therefore personally responsible for what is commendable; and second, it will produce a training school to develop men for advanced positions.

When the subject of organization is the uppermost thought in a man's mind, it is surprising from what sources he gets information.

The successful baseball team has one man who says who shall play and how he shall play. This one man is on the ground and as close as possible to the practice and playing. As soon as the stockholders, directors or president enter this man's field of authority, the team goes to pieces.

The Salvation Army first convicts a man of sin before he can be saved by their religion. So the boss must first convince a man of error before he can be taught. The man must want to learn to do better work before you can teach him.

A business day finds the manager confronted with many troubles. Customers complain of slow shipments, and poor quality of goods; others complain of bill not arriving in time to check goods in; some ask for extensions of time, others for discount from prices named; and the report from the auditor sometimes shows a loss in manufacturing a certain shipment where a profit was estimated. There seems no end to the petty routine

things that deserve attention along with the more serious ones.

The problem which presents itself is, shall the manager devote his day to dictating excuses and apologies, or shall he spend his time trying to cure the cause of the complaints which litter up his desk?

If he follows the first course, he makes himself a clerk and deprives the business of the managerial quality which is its due. If he follows the second course, he gives the business the benefit of the brains, experience, and authority, which the business pays him to exercise. The routine work of the desk and office can be delegated to a clerk to be done under the supervision of the manager, but the cure of the causes of the trouble can not be delegated. No one but the man in whom the authority is vested can remove the causes of trouble so as to prevent their recurrence. A careful examination of the routine work will develop the fact that only 5 or 10 percent of the mail requires the manager to dictate the actual replies.

Where there is no purchasing agent, time can be saved by letting a clerk hear the salesmen offering goods, and then tabulate the information, showing origin of shipment, time of delivery, freight rate, price of goods and quality, so that the manager can decide the purchases in a few minutes.

Suppose the manager now free to perform the functions for which he is employed. In starting in to cure the causes of troubles, the precedent of yesterday must not control. The problem must be considered as a new one and a method determined which will produce results in the best, cheapest and most certain way. Yesterday's way may be right, but not necessarily so. Men's minds are prone to get in a rut, and the method of yesterday becomes a fetish. The manager's mind must have a definite reason for each movement and he must be certain that the lost motion of yesterday is not permitted to grow on his business like a fungus. The manager who can't cut red tape and throw precedent to the dogs when they impede business has much to learn.

He takes up first, the matter of delay in Jones & Company's shipment which was promised today, and in regard to which he is informed that unless the shipment is made today the business will be lost. He finds shipment delayed because some necessary material is not on hand. Investigation showed that the store keeper delayed making the requisition on the purchasing agent promptly. The purchasing agent wanted to save one cent apiece on each unit and placed the order at a considerable distance. Number of units in shipment, three thousand, saving $30. Estimated profit on delayed shipment, $200. Annual value of customer in profit, $2,500. Superintendent not to blame because the manager appointed and controls both purchasing agent and storekeeper. Manager too busy at desk explaining why things did not happen to show purchasing agent and storekeeper how to make things happen. Purchasing agent anxious to make a showing for his department, not to blame because he was carrying out orders to buy cheaply. Not to blame for the further reason that storekeeper did not make prompt requisition.

Storekeeper is put under control of factory superintendent with instructions that he will be trained so that delays will not occur, and if he can not be trained by the superintendent, the superintendent shall replace him. This is done because the superintendent is in constant touch with the storekeeper and can keep better watch over him; can better teach him and can therefore better be responsible for him. The superintendent has probably frequently complained of the storekeeper's shortcomings. He has felt that he knew them better than the manager did. He now has the authority and will be charged with the responsibility to cure them. The superintendent will have it made clear to him the large amount of brains necessary to be used in seeing that the storekeeper properly performs his functions; he will have pointed out to him the necessity of keeping enough stock on hand of each standard kind to make prompt shipment of goods, and at the same time have impressed upon him the importance of keeping his stock on hand as small as possible, thereby keeping out dead stock and lessening the heavy load which the inventory is on the working capital of the business.

The manager now explains to the purchasing agent in such a way that he can not misunderstand him, that the purchasing department is but a cog in the wheel and that it is operated to make a profit for the stockholders, and that the business is not run to make a showing for the purchasing department. Costly delays will in future be charged directly to him. Conversation will not be accepted as an excuse for lack of judgment. In times of doubt the manager is ready and has the time to advise with him.

In actual practice, the cure suggested may not seem advisable. The case is cited only to emphasize the principle that some one man in authority shall be responsible for each act of each subordinate.

As a manager seeks for the causes of the various troubles he will find the man who did not act, or who acted improperly, and each case he will put the most convenient sub-boss in authority over the man in error, and charge the sub-boss with the responsibility of seeing that the work in future is done promptly and properly.

The manager on returning to his desk to glance over the routine correspondence of his clerk, will feel that while his eyes can not reach everywhere, he has left in each department a pair of eyes to see for him. He has left the authority to cure the mistakes each pair of eyes see, and he can now hold some one responsible for what happens. Tomorrow there will be fewer complaints for which to apologize. He will have time to think. He can use his head and earn a manager's salary in place of using his hands and earning a clerk's. He has time to come into intimate contact with his men in man-to-man fashion and show them that he and they are human—made of the same clay, and that he in his capacity is striving as hard as they in theirs to serve the same end.

At the end of the year he can feel that his men are all keeping step and, most important of all, he can give his stockholders increased profits in place of explanations.

ZINC IN INDUSTRY

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latest development of paint science, and defies the conventional belief that white paint cannot stay white. When one considers the number of structures in this country on which white paint is used an idea is gained of the potential market opened up.

Lithopone also enters into the manufacture of lacquers. With ground cork, lithopone is the base of linoleum, a product which now uses large tonnages. Another large outlet for lithopone is as a filler in rubber tires and mechanical rubber goods. Printing inks and leather finishes take good sized tonnages.

The rapid progress of industry and the changes which scientific research dictate prevent any safe prophecy as to the increased specific use of zinc in its various forms. New uses are constantly being found for it and it is essential in most of the operations where it is now used.

GEOPHYSICAL PROSPECTING

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This development is practically in its infancy and much correlation of work of the individuals working along such lines is required in order to bring about the anticipated results at an earlier date than if each individual is working out these problems without technical intercourse or exchange of their findings. There is room in this field of research of variegated sciences for many and in the application of these methods to a securely practical end.

MODERN TYPES OF GAS MASKS AND RESPIRATORS FOR MINES

Modern Type Gas Mask And Respirator, To Provide Protection Against All Industrial Gases, Is Outgrowth Of Mask Developed During World War To Protect Soldiers Against Poisonous War Gases

By J. T. RYAN*

THE modern type of gas mask and respirator, to provide protection against all industrial gases, is an outgrowth of the gas mask developed during the World War to protect the soldiers against the poisonous war gases.

Poisonous, irritating and explosive gases are found in almost every industry and hours could be consumed in relating the great variety of conditions for which we are called upon to provide gas mask protection, such as protecting the operators in horse-radish factories, fumigators of homes and ocean liners, and men engaged in the manufacture of tetra-ethyl-lead, the new motor fuel. So far, we have been able to develop ample mask protection for all known noxious gases and fumes that are present in atmospheres encountered in mines, metallurgical works, chemical and other industries, so long as there is sufficient oxygen present to support the flame of an oil lamp.

The most important development of the gas mask was in providing protection against carbon monoxide—which is the noxious gas that mining men are most concerned with and, in fact, is the noxious gas that man is most frequently exposed to.

As this is a mining section meeting, this paper will be confined largely to the discussion of masks for underground use in metal mines.

Gases that contaminate the normal air in mines can be divided into two classes: those that are given off normally by the workings, and those that are produced in the operations.

Gases coming under the first class are, fortunately, of rare occurrence in metal mines and are confined to CO_2, which has been found issuing from the strata in underground workings of certain districts, notably Cripple Creek and the Tintic district of Utah. Methane (CH_4), the gas which is common to coal mines and most dreaded because of its becoming explosive when mixed with the right proportion of air, is also found in some metal mines—for instance, in some of the iron mines of the Birmingham, Ala. district. Methane has no harmful respiratory effect. Its chief hazard is its explosibility and reducing the oxygen content of the air by dilution to where it might be unbreathable. CO_2 is also not harmful except in fairly large concentrations and continued exposure above 5 percent. It is apparent, then, that there is little respiratory hazard in metal mines from gases given off from the strata, and the same is true, to a lesser extent, of gases produced under normal operations.

The contamination of the air in normal metal mine operations is largely CO_2 produced by the breathing of the men, burning of lamps and oxidation of wet mine timbers, accompanied by depletion of oxygen. The other principal source of contamination is from explosives. The more harmful gases evolved from the use of explosives being CO, SO_2 and NO (Nitrous Oxide, which quickly oxidizes to NO_2), all of which are very dangerous to breathe even in small quantities; also the less harmful gases, CO_2 and CH_4.

The remedy for all the foregoing is proper ventilation to dilute these gases below the harmful percentage. The writer is happy to state that wonderful progress has been made in recent years in metal mine ventilation.

As the hazard from noxious gases (requiring protection) in the normal operations of metal mines is comparatively slight, we will now turn to abnormal conditions, and we find that mine fires are the principal source of generating noxious gases, as is the case in coal mines.

Mine fire gases are principally CO_2, CO and sometimes SO_2, H_2S and CH_4, and finally oxygen deficiency. CO_2, as previously stated, only becomes dangerous in quantities exceeding 5 percent. CO is a hazard, as determined after an exhaustive investigation by the Bureau of Mines, when four parts per 10,000 (or .04 percent) is present and the exposure is for two or three hours. A concentration of .3 percent is very dangerous in a short time and will cause a blood saturation of 60 percent in from 20 to 30 minutes. Sulphur dioxide is very poisonous in even small quantities but, fortunately, it is very irritating to the eyes and respiratory passages and is intolerable to breathe before it reaches concentrations that are dangerous, thus providing its own warning.

Oxygen, according to Dr. R. R. Sayers, is the most important to man of the gases in the air. "Man is so made that he breathes easily and works best when the air contains about 21 percent of oxygen, which is the amount in normal air, yet he is able to live and work, though not so well, when there is less oxygen. If about 17 percent of the air is oxygen, a man at work will breathe a little faster and a little deeper." Haldane says that under certain conditions men may be conscious even with as little as 3½ percent oxygen in the air they are breathing. Under most conditions men faint or become unconscious when the air contains 9 percent to 11 percent oxygen.

The presence of carbon monoxide in the air at a mine fire is the most frequent cause of poisoning—in fact, it may be safely considered the sole cause, because before the CO_2 can occur in a dangerous quantity there is always sufficient CO to asphyxiate and before the fire has depleted the oxygen to 15 percent there is invariably sufficient CO to be harmful. It can be safely stated that carbon monoxide represents 90 percent of the noxious gas hazard of metal mine fires. In addition to its being very poisonous it is insidious, as it gives no warning, and a lamp gives no indication of its presence.

Until recently, the only protection for a man to penetrate atmospheres containing CO was the self-contained breathing apparatus, which provides excellent protection, but its weight and mechanical complications limit the exertions and amount of work that can be performed by the wearer and necessitates specially trained men, which limits its use.

The World War developed many complicated problems of gas protection, the most difficult of which was that of providing mask protection for CO, particularly in the Navy and to some extent around machine gun nests, underground tunnelling, where, in each case, carbon monoxide constituted a decided hazard.

Our Chemical Warfare Service found little trouble in developing chemical absorbents for most gases, except CO, which proved exceedingly difficult. A group of 20 or more of our best scientists worked at the outset under the direction of the U. S. Bureau of Mines, devoting efforts to the finding of a material which could be placed in a gas mask canister and which would destroy carbon monoxide. One of the outstanding accomplishments of our Chemical Warfare Service was the development of a chem-

* Mine Safety Appliances Co. Paper delivered to the Mine Safety Section, Pacific Safety Conference, August 31.

ical which effectively catalyzes carbon monoxide to carbon dioxide, a comparatively harmless gas. Of particular interest to you mining men of California is the fact that it derives its name from Johns Hopkins University and the University of California and is called Hop-Cal-ite, as it was developed by two groups of scientists working simultaneously at both Universities.

The All-Service Gas Mask

We saw the possibilities of applying this material to a gas mask for mining and industrial use to protect against carbon monoxide, and immediately following the close of the war acquired the patent on Hopcalite and employed some of the men who had discovered it to continue their research work and develop a light, comfortable mask that would provide complete protection against all mine and industrial gases, or any combination of them, so long as there was present in the air sufficient oxygen to support the flame of an oil lamp, which is 16½ percent. Three years of further intense research work resulted in the development of the All-Service Gas Mask which provides perfect protection against carbon monoxide and any combination of noxious gases that may occur in mines, industrial and metallurgical plants where the oxygen has not been depleted below what will support the flame of an oil lamp or candle—or, in other words, it provides protection against all gases except oxygen deficiency and it can be worn safely wherever an oil lamp will burn.

The Bureau of Mines, in its investigation of gas masks in mines and allied industries, has established a permissible Schedule, 14 A, under which masks that meet their requirement after being submitted to exhaustive tests are granted a certificate of approval. The All-Service Gas Mask has been approved by the Bureau of Mines under this schedule for respiratory protection in mine atmospheres where safety lamps are burning, and for use above ground *in air* that contains acid gases, organic vapors, or carbon monoxide not exceeding 2 percent by volume, ammonia not exceeding 3 percent, and in smokes, dusts and mists—or not exceeding 2 percent of total poisonous gases when more than one gas is present.

The final test of the bureau for approval was to subject the mask to an actual working test by three men wearing it in an unventilated, gas tight chamber of 1,000 cubic feet capacity, to which had been added the following gases in the percentages as stated, and determined by analysis:

Sulphur dioxide, (1) one percent.
Carbon tetra chloride, (1) one percent.
Ammonia gas, (2) two percent.
Carbon monoxide, (2) two percent, and again at (0.5) one-half percent.
Cotton smoke—the density of which was such that the hand was invisible at arm's length.

The three men wore the masks for a 30-minute period in each of these concentrations, performing, successively, hard work, walking, and running. The bureau's published report of the approval states that "The masks gave good protection throughout all of these tests; they were comfortable and there was little interference with movements; vision was good and of fairly wide angle; and resistance to breathing was tolerable through all the work required."

In addition to the actual wearing tests of the complete masks, the canister was subjected to separate tests against the following gases—chlorine, hydrocyanic acid gas, sulphur dioxide, phosgene, carbon tetrachloride, gasoline, ammonia and carbon monoxide, in varying percentages required by the schedule, from (0.5) one-half-of one percent of sulphur dioxide to (4%) four percent of carbon tetrachloride and ammonia, and (1%) one percent of carbon monoxide under the worst possible conditions for the operation of Hopcalite—namely, at a temperature of O°C and 100 percent relative humidity. The air flow in these tests was 32 liters per minute, about the rate of breathing for the average man when working, and some tests were made at 64 liters per minute.

This test against one percent of CO was for a period of 460 minutes, or seven hours and 40 minutes, without CO coming through the canister. We have, in our laboratory, run canister tests under more normal conditions of temperature and humidity for days without CO coming through when the air flow of 32 liters per minute contained one percent of CO.

The canister of the All-Service Gas Mask is filled with successive layers of six chemicals separated by wire screens and cotton filters. The function of the first three chemicals from the bottom upward is to remove, by absorption, all the noxious gases other than carbon monoxide. They have a definite life or absorption capacity but break gradually and permit a very small quantity of poisonous gas to pass, then gradually more and more. The cotton filters are to remove smoke and dusts, and they function so well against smoke that you can enter a concentration such that you can not penetrate with a flash light and not detect the least trace.

Immediately above the third layer of chemical is a quantity of fused calcium chloride to protect the Hopcalite (the fifth layer of chemical) from moisture, which retards the catalytic action of Hopcalite in converting CO to CO_2. The Hopcalite is further protected by a layer of calciumchloride dryer, which is the sixth or top layer of chemical. It is well to emphasize at this point that while all the chemicals, other than Hopcalite, function as an absorber and have a definite life, Hopcalite is not an absorber but functions as a catalyst, merely by its presence causing carbon monoxide to take up oxygen from the air, converting it to harmless carbon dioxide, and this action will continue almost indefinitely if it is kept free from moisture, its principal poisoning agent. It should be further emphasized that an amount of Hopcalite beyond that used in the canister is not necessary, and any percentage of CO in the air, up to 5 percent, does not materially affect its life. As a matter of fact (0.5%) one-half of one percent was found to be the most difficult percentage to protect against, and as the percentage of CO is increased above that amount the efficiency of Hopcalite increases.

The conversion of CO to CO_2 by the Hopcalite produces heat and accelerates its action, and when the temperature reaches 212°F., which vaporizes the moisture, the poisoning effect of moisture ceases and the Hopcalite will continue to function for days, even though the dryer is no longer operative. These were mechanical tests on the canister, as these temperatures would only be breathable for a short period by a wearer of the mask. Wearing the mask in 2 percent of CO causes such an increase in temperature that at the end of 30 minutes the temperature becomes unbearable, forcing the wearer to retreat. This rise in temperature is the warning or safeguard against high concentrations above 2 percent, which never occur underground except when the oxygen has been depleted below 15½ percent, and then it is extremely rare to find as much as 2 percent of CO.

The Bureau of Mines have analyzed thousands of samples of mine air following mine fires in metal and coal mines and explosions in coal mines, many of which have been published. An examination of 328 of these published analyses, under the heading of abnormal atmospheres, discloses that only three of them show CO in excess of one percent and none of them show 2 percent. A further examination of the published analyses of samples of gases from metal mine fires shows that only one exceeded 2 percent. This sample was taken at the Butte mine fire from behind a bulkhead and showed 2.09 percent CO, but only (0.3%) three-tenths of one percent of oxygen. The worst metal mine fire sample shown, as published by the bureau, and from an unsealed section, showed 1.17 percent CO but only 14.43 percent of oxygen. This sample was taken close to the new fire in 1308 drift at Butte.

Mr. B. O. Pickard, in his extremely interesting paper "Lessons from the Fire in Argonaut Mine," published as Technical Paper 363, records a number of analyses of samples taken at the 2,400 foot level of Argonaut mine. The worst one, taken seven days after the discovery of the fire, showed .9 percent CO; 13 percent O_2; and 6.2 percent CO_2. One could not work in this atmosphere with a gas mask as there is not sufficient oxygen and this is an atmosphere for breathing apparatus only. Although if a man was forced to remain in this atmosphere with only an All-Service or Self-Rescue mask for protection he would be provided with perfect protection against the CO for a long period and would be overcome finally from the lack of oxygen and high CO_2.

With the All-Service Mask an accomplished fact, it soon became evident that the family would not be complete without the advent of its little brother—namely, the Self-Rescuer—designed for use of the individual miner in the event of his being caught in the fumes from a fire or explosion in the mine. A perusal of the data gathered by the U. S. Bureau of Mines shows that in most mine explosions and mine fires where there was loss of life, the majority of those killed succumbed to the afterdamp. Protected against the carbon monoxide, many of these men could have made their way to fresh air uninjured, the possibility of their going down for lack of oxygen being quite remote.

The Self-Rescuer is provided with Hopcalite for catalyzing the CO to the harmless CO_2, and suitable filters for eliminating smoke. It has been tested by the U. S. Bureau of Mines under Schedule 14-A and officially approved. The tests preliminary to approval are reported in U. S. Bureau of Mines Report of Investigations Serial 2591, wherein it is stated "The Self-Rescuer removes the hazard of carbon monoxide for one-half hour or more and accordingly greatly increases the miner's chance of saving his life." The truth of this statement has since been amply demonstrated upon a number of occasions. Following a mine explosion in Alabama a few months ago, over 20 lives were saved with it, as reported by a mine inspector who was present.

The Self-Rescuer is enclosed in a hermetically sealed container entirely protected from the elements, and weighs, ready for use, 13 ounces. It can be carried on the belt or in the coat pocket. It can also be made available by cacheing in small lots throughout the mine. Many rescue stations are adding it to their equipment, including a large metal mining operation in the southwest. This makes it available for taking into the mine for distributing to any who are found in a condition to use it while being brought through the gaseous area to fresh air. It is also carried by the rescue crews to supplement their oxygen apparatus or All-Service Masks.

In the event of a metal mine fire, where sulphide ores are encountered, the Self-Rescuer would protect against the SO_2 as well as any CO which might be generated from burning timbers.

Mention might also be made here of the pocket respirator which is comparable in size and construction to the Self-Rescuer, but is not put up in the sealed container as the chemicals used in it do not deteriorate in air. It is intended for protection against comparatively low concentrations of sulphur dioxide and smoke, being developed originally for protection against locomotive smoke encountered in railway tunnels. It has since proved very helpful in taking care of sulphur dioxide in the smelting of sulphide ores. Two smelting operations are using it in large numbers for this purpose. Due to its lower cost it has also been installed in one metal mine for sulphur dioxide protection in case of a fire, care being taken to use it only where there is no carbon monoxide, as determined by a suitable CO Detector.

Application of the All-Service Mask and Self-Rescuer for Underground Use

The All-Service Mask can be worn safely in any atmosphere, regardless of what gases may be present, that will support the flame of an oil lamp or candle, because it will give perfect protection against any combination of gases that can occur with 16½ percent oxygen present. The only definite recommendation, then, covering the use of the mask is "that it only be worn where such lamp will burn and when the lamp or candle is extinguished the wearer should retreat." A carbide lamp should not be used as a warning indicator because it will not be extinguished until the oxygen is reduced to 13 percent, and this is not sufficient margin of safety.

Its use, therefore, is limited to this condition and only breathing apparatus should be used beyond this point.

Its advantages of light weight (only 5½ pounds), simplicity and quickness of application, recommend it as a valuable auxiliary or supplementary equipment for rescue stations, and practically all coal mine rescue stations are now equipped with them.

Mine fires are the principal catastrophe and property hazard in metal mines. A fire is always small at its inception and minutes at the start are more valuable than days later on. The principal reason for most fires getting beyond control is the inability of workers without protection to get to the seat of the fire in its incipient stage, on account of the smoke and fumes principally, and small amounts of CO and SO_2 which can not be penetrated without protection. Breathing apparatus does not lend itself to this condition because valuable time is wasted in getting word to the rescue station on the surface and assembling the rescue crew and apparatus. In the meantime the fire is usually beyond control and the fumes have penetrated the workings, endangering all the men unless they have with them, or close at hand, Self-Rescuers which will give them perfect smoke protection and CO protection to one percent for a long period of time.

The application of the mask to this condition is to have some of them available underground and on the surface so that men who have had some previous training with them can get to the seat of the fire and extinguish it, or keep it in check until the rescue teams equipped with breathing apparatus can get on the job. Even then it will be found of advantage to continue the use of the mask as long as conditions permit, holding the rescue teams in reserve for emergency and exploration work. The best fire control is lack of oxygen and if a lamp will not burn the fire is well under control.

Another application of the mask and Rescuer is for carrying by the breathing apparatus crew members to provide protection for men found alive, enabling them to be brought through irrespirable gases to fresh air. If the men are alive they have sufficient oxygen and all they need is protection against the noxious gases, which the mask and Rescuer provide.

Still another important use of the mask is to provide officials, in case of a fire, with protection so that they can get near the seat of operations and direct the work.

The writer, a short time ago, in preparing a paper for the American Mining Congress on the subject of "Fighting and Sealing Mine Fires," sent out a questionnaire to 90 mining men experienced in mine fire fighting in the United States, Canada and Great Britain. One question asked was "Have you used carbon-monoxide gas masks as respiratory protection while sealing fires? If so, to what advantage?" A few more than half replied that they had used gas masks to advantage and the others had not used them, although several of the latter believed them to be of value.

In conclusion, I want to emphasize that the All-Service Mask has its very definite limitation for use, which is that it must not be worn where an oil flame will not burn and it can not take the place of oxygen breathing apparatus for all work, but should be considered an auxiliary (*Continued on page* 685)

THE NATION'S VIEWPOINT

A Digest Of The Expressed Opinions Of Leaders In American Affairs

THE development of our potash resources has been given added interest by the release of the Department of Commerce, upon the history of the German Syndicate which is furnishing America her potash. The *Washington Post* believes that tariff protection is the next step in the development of our resources, saying:

"The chief of the chemical division of the Department of Commerce has given out a history of the potash industry in Germany and the German-French combination now controlling the sale of potash in the United States, and the possibilities of obtaining potash in Poland. He has little to say about American production of potash, merely remarking that 'unhappily production of potash in the United States has been under a cost of production much greater than that of European potash.' Labor and materials are more costly here, of course.

"When the tariff bill of 1922 was being framed the protectionists interested in the production of American potash undertook to foster the American industry by means of a moderate tariff, reduced annually for a series of years. However, the western farmers demanded that potash be placed on the free list, and it was done.

"If Congress would protect the American potash industry for a reasonable length of time, the United States would become independent of Germany, France, and all other countries for the bulk of its potash, and the price would be lower than the foreign price."

The *New York Times* likewise believes that the development of our potash beds is the only way in which we can dissolve the Franco-German combination, and point out:

"Potash is on the free list, and it is not possible for American law to dissolve the Franco-German combination which monopolizes the world potash trade. The best hope of cheapening the fertilizers of which our farmers use too little is to develop domestic supply. Already active steps are being taken under the grant in aid passed by Congress. In supporting the bill Secretary Hoover stated that the world's largest potential natural deposits lie in Texas, New Mexico and Utah. The plan is that Federal funds shall be spent under contracts with owners, giving the right of fixing the price to the Secretaries of Commerce and Interior. Potash stronger than the German has been discovered at a fraction of the depth of the German. During the war we produced the potash we used, but the price rose to four and six times the foreign. Even before the war our farmers were restless against the prices of the imported fertilizer, and it is said that over $30,000,000 has been spent in the attempt to create an American industry.

"Recently the American Chemical Society declared that the Searles Lake works in California are producing more potash than any single foreign mine and more than the maximum total production of this country during the war. Other producers were discouraged when imports were resumed and prices fell. It is not possible wholly to reconcile the price statements made by the Department of Commerce and the American importers of German potash. It is desirable that there should be a minimum of recrimination and a maximum use of potash. Fertilization is the first thing the farmers neglect when their profits fall, with the result that our recently virgin soils produce less than foreign acres which have been cropped for centuries. Cheaper potash means larger crops."

Wallace Press-Times.
Left Behind

Despite the tariff imports from foreign countries have increased steadily, therefore, according to *The Washington Post*, exploding the off-repeated statement that the United States can not sell unless it is prepared to buy. They further state:

"After the World War it was declared repeatedly that the United States could not sell unless it was prepared to buy, and that as any increase in import duties would prevent foreign countries from buying from the United States, the United States could not possibly sell to foreign countries. It was predicted that under the high tariff foreign trade would be curtailed, or possibly ruined.

"The chief of the Bureau of Domestic and Foreign Commerce reports that American exports of manufactured commodities in 1926 were about 16 per cent ahead of 1925, and that they were some 60 per cent ahead of 1921 and 1922. They were nearly three times the annual average for five years prior to the war.

"This tremendous growth testifies to the rising efficiency of American industry and explodes the fallacy of the oft-repeated claim that the United States can not sell unless it is prepared to buy in an equal or larger amount. Despite the increase in the tariff, imports from foreign countries have increased steadily every year since 1921. The increase since 1921 has been approximately 75 per cent; while imports in 1925 were about four times the average imports during the five years before the war.

"This demonstrates that the tariff has no appreciable relation to foreign commerce. The tariff holds down the

sales of foreign manufacturers in the American market, but it does not prevent American manufacturers from extending their foreign trade."

From time to time there appear general statements as to the rapidly decreasing iron ore reserves of this country. In some instances writers have gone so far as to insist that our reserves will be exhausted within 50 years. The *American Metal Market* does not agree. In a recent editorial they say:

"Comment made in some quarters on a recent Federal Trade Commission survey of iron ore reserves makes it well to remind the public that there is absolutely not the slightest reason for any concern on this subject. The American Metal Market holds no opinion as to the precise accuracy of the findings of this survey, but such consideration as anyone can give to the points involved, leads clearly and easily to the conclusion that there is no problem presented.

N. Y. Evening Post.
Closing the Incident

"The statement in brief is that there is about 8,000,000,000 tons of iron ore known in the United States, only a limited amount containing more than 50 percent iron, and that two steel companies control well over half the amount.

"Well, whom would you expect to control it? To whom do men go when they discover ore, anxious to get something out of their fields? We have never mined as much as 70,000,000 tons in a year, and at that rate the known reserves would last over a century. The individual does not care to wait and his interest in grandchildren does not take that form.

"Some of the commentators find another mare's nest in the fact that only a limited amount of the total reserves is 'of high grade, i. e., over 50 percent iron.' It ought always to have been known, on general principles, that if an industry has a good start and can see a few years ahead its technicians can solve the problems that are going to come up. At this late date we do not need to depend on general principles, for we have the actual history of this thing working out. They say, for one thing, that it is 'expensive' to smelt these 'low grade' ores. Well, the record is that in 1897 and 1898, when the cream of the Mesabi range was being shipped, the average limestone consumption in making coke and anthracite pig iron was a trifle over 1,000 pounds per gross ton of pig iron. For each year 1900 to 1903 inclusive it ran above 1,200 pounds. Those were active years, when more ore than the best had to be taken. But in the past few years the most active years have shown about 1,000 pounds and the leaner years a few percent less.

"The limestone consumption is a good measure of the success in iron smelting. The ores have grown somewhat leaner, but practice has improved. A quarter century ago there were some lurid predictions about how the really worth while ores would all be gone in less than half a century, but with more than half of the time elapsed we are doing better, not worse. So it will be in the future.

"Blast furnace improvement is one thing, and ore beneficiation another. The latter has helped to sustain the average iron content of Lake Superior ores as shipped. But when anybody says, as some do, that only a limited amount of our iron ore reserves are 'high grade, i. e., 50 percent or more iron' he is a few decades in the past. The average iron content of all the Lake Superior iron ore shipped last year was only 51.74 percent. If there is any trouble, we are almost in it now, only 1.74 percent away, but back in 1916 we were in more trouble only no one told us, for in that year the Lake Superior shipments averaged only 51.20 percent. A lot of that ore was really under 50 percent, of course.

"There is absolutely no occasion for the slightest uneasiness either as to the ore available or as to who owns it."

The report of the Royal Commission of Indian Currency and Exchange, has brought forth the following comment from the *Nevada Mining Press:*

"The three silver brokers in London who fix the price of silver day by day have taken full advantage of the report by the Royal Commission

© *Kansas City Star.*
Not For Me

of Indian Currency and Exchange, recently made public, which has for its ultimate aim the establishment of gold as the money metal of India. The report recommends the stabilization of the East Indian rupee at 1s 6d and further proposes that this ancient silver coin shall be legal tender only up to the amount of 50 rupees; and that silver holdings in the reserve shall be gradually reduced during the next 10 years. Taking advantage of the situation and intimations that the Indian government may offer silver for sale, if the report is accepted and the recommendations carried out, the speculators have been successful in breaking the price a few points. With the memory of the crisis of a few years ago still fresh in the British mind, it would seem that the sage statesmen of the empire would hesitate about monkeying with this buzz-saw of Indian finance. It will be recalled that the lack of silver in India during the World War almost brought about a revolution there, and probably would have done so had the United States not come to the rescue and melted its silver dollars and sold the metal to the British government. This country at that time had the only large supply of silver of the world. So far from showing gratitude for the part we played in rescuing the empire from this crisis, Great Britain with the war over started again to depreciate the price of silver."

Considerable speculation has taken place concerning just what the President's "Spokesman" meant by the recent statement from the Summer White House that the President favored coal legislation. *The Black Diamond* has the following to say:

"From time to time stories are car-

ried in the newspapers to the effect that President Coolidge believes there should be legislation enacted for the purpose of setting up a temporary board to adjust difficulties in event of an emergency and for setting up a coal administration, if a scarcity of coal is threatened. The pressure from certain quarters is based upon the premise that a scarcity of coal can or will exist. There might be certain conditions when such an emergency would exist, as, for instance, during a war, but only then would the governing power be justified in attempting to take over the coal industry either temporarily or otherwise. It will not be seriously contended, for instance, that the anthracite strike, as long as it lasted, caused any scarcity of coal. It may have caused some inconvenience, it is true, but it did not result in a scarcity of fuel.

"There will be no scarcity so long as there are so many existing sources of supply. If the United Mine Workers controlled the entire output, then it would be a different matter and it might be logical to create the necessary machinery to deal with such situations as might grow out of arbitrary action taken by the union, but so long as the union does not have the power to create a scarcity, as was demonstrated during the anthracite suspension, then why seek to prepare for a situation which can not exist?

"Were the coal situation in this country analagous to that in England, then it might be a different matter. There it is within the power of the union to shut down all the mines and to suspend production entirely. But the situation in the United States is not analagous to that in England.

"The experience of the railroads under Government regulation should be sufficient to deter authorities from trying the same experiment with the coal industry, even in a limited way, for the minute regulation is attempted the political factor enters into the equation and the economic factor is lost to sight.

"The fact is lost sight of by Congressmen and Senators, in urging that the same machinery be set up for the coal industry as in the Watson-Parker Railway Labor Act, that the railroads and the brotherhoods joined in asking for such legislation and that neither the operators nor the miners are asking for similar legislation for the coal industry, and for that simple reason it is probable that such legislation never will be enacted, however strongly urged it may be by some of the President's advisers."

Kansas City Star.

Must Have Worn Out Our Welcome 'R Something

The Baltimore & Ohio Railroad seemingly has brought success out of chaos in its labor situation. A bird's-eye view of how this was accomplished is given in a recent editorial in *The New York Times*, which says:

"Three years ago the Baltimore & Ohio Railroad agreed with the shop crafts unions affiliated with the American Federation of Labor to cooperate in an attempt to increase production and to improve working conditions. The management bound itself to recognize the unions, to deal with them, and, as far as possible within the limits of existing railroad wage standards, to allow their membership a share in the benefits that might follow. The unions pledged the shopmen to strive for efficiency. A system of meetings between the company and men was set up. The experiment was first put into operation with 300 men in the Glenwood shops. A year later the plan was applied to the entire force of 22,000 shopmen on the road.

Columbus Dispatch.

Chasing the Magic Goose

It has subsequently been adopted by the Canadian National, the Chicago & Northwestern, and the Chesapeake & Ohio Railroads, and embraces today over 50,000 men.

"Mr. O. S. Beyer, Jr., who, as consulting engineer for the shopmen's unions, shares the credit with President Willard, of the Baltimore & Ohio, for the plan's development, sums up the results of its operation in *The New Republic*. He mentions the following gains: (1) Elimination of unemployment in the B. & O. shops; (2) decline in grievances submitted for adjudication on the same road from an average of 1 in every 58 men to 1 in every 131; (3) a total of 20,000 suggestions for increased shop efficiency, better working conditions, more satisfactory recruiting of employes, etc., 16,000 of which have actually been put into effect. In addition, Mr. Beyer cites intangibles of even greater importance, which may be summed up as an 'increased sense of responsibility on the part of employes for the success of the railroad and on the part of the management for the welfare of the employes.'

"The great failure of modern industry has been to furnish an incentive to the wage worker sufficient to elicit his wholehearted support in production. The average factory worker sees no connection between his wages and his daily output. The philosophy of labor unionism is based on the assumption that the way to increase wages is not to increase production, but to coerce the employer into paying more. From this has flowed a train of evil consequences—soldiering on the job, ca' canny, sabotage, with waste beyond calculation. As a result, the vast mechanism of modern production halts and often fails altogether.

"The B. & O. plan has the great merit of facing this issue and offering a remedy that respects the rights and interests of both employer and employed. Its present weakness, as Mr. Beyer points out, is the lack of definite correlation between increased output and higher wages. The elaborate and fixed wage structure of the railroads which makes different wage scales on different roads impracticable at the present time, and the fact that production in repair work is more difficult to measure than in ordinary manufacture, have hampered the experiment. But its remarkable success in spite of these odds makes it even the more impressive."

GYPSUM MINED AND SOLD BY PRODUCERS IN 1925

THE gypsum industry was highly productive in 1925, according to a statement of the Bureau of Mines, based on reports received from 62 operators in 19 states, and collected in co-operation with the Geological Surveys of Iowa, Kansas, Michigan, New York, Texas, Virginia, and Washington. The quantity of gypsum mined in 1925 was 5,678,302 short tons, which is the largest output ever recorded and exceeds that of 1924 by more than 600,000 tons, or nearly 13 percent. The value of the sales of both crude and calcined gypsum was $47,893,573, an increase of more than $5,000,000, or 12 percent, compared with 1924. Over 1,000,000 tons was sold crude and 4,104,735 tons was sold calcined. The value of the gypsum sold crude was $2,823,229, or $2.78 per ton, and the value of that sold calcined was $45,070,344, or $10.98 per ton. New York is the largest producer of gypsum. The production of crude gypsum in that state in 1925 was 1,730,254 short tons—30 percent of the entire output—an increase of 17 percent compared with 1924. It was also the largest seller of crude and calcined gypsum, 354,394 tons of the former (or 35 percent of the total) and 1,193,520 tons of the latter (or 29 percent of the total) being marketed in New York in 1925. These were considerable increases over 1924. Other important states in the production of crude gypsum were: Iowa, 800,167 tons; Michigan, 649,053 tons; Texas, 558,132 tons; and Ohio, 551,479 tons. These five states reported nearly 76 percent of the total.

CRUDE AND CALCINED GYPSUM SOLD BY PRODUCERS IN THE UNITED STATES IN 1925, BY STATES

State	Number of plants reporting	Total quantity mined, short tons	Sold crude		Sold calcined		Total value
			Short tons	Value	Short tons	Value	
Iowa	7	800,167	140,451	$381,584	562,210	$6,352,687	$6,734,271
Kansas	3	166,952	52,869	126,886	87,656	882,624	1,009,510
Michigan	5	649,053	155,961	391,093	477,076	5,056,201	5,447,294
Nevada	6	350,130	31,471	57,073	259,693	1,664,736	1,721,809
New York	10	1,730,254	354,394	1,017,403	1,193,520	15,518,836	16,536,239
Ohio	3	551,479	11,423	32,818	540,504	6,361,314	6,394,132
Oklahoma	4	320,931	53,286	122,666	232,660	2,476,797	2,599,463
Texas	6	558,132	28,396	69,487	426,710	3,652,467	3,721,954
Other states[1]	18	551,204	185,884	624,219	324,706	3,104,682	3,728,901
Totals	62	5,678,302	1,014,135	2,823,229	4,104,735	45,070,344	47,893,573

[1]Arizona, California, Colorado, Montana, New Mexico, Oregon, South Dakota, Utah, Virginia, Washington and Wyoming.

TALC PRODUCTION IN 1925

THE total quantity of talc mined in the United States and sold in 1925 was 182,256 short tons, valued at $2,011,793, according to a statement prepared by the Bureau of Mines, which was compiled from individual reports of producers. The figures comprise 5,684 short tons of crude talc, valued at $24,533, 895 tons of sawed and manufactured talc, valued at $107,691, and 175,677 tons of ground talc, valued at $1,879,569. They represent an increase in quantity of 2 percent and a decrease in value of nearly 10 percent, as compared with 1924. There were 23 producers of talc in 1925, the same as in 1924.

Of the total quantity New York sold 85,109 short tons, valued at $993,913, as compared with 78,340 tons, valued at $1,162,488 in 1924; Vermont sold 54,883 short tons, valued at $533,603, as compared with 61,653 tons, valued at $573,747, in 1924; and California sold 14,883 short tons, valued at $194,975, as compared with 16,335 tons, valued at $247,799, in 1924. The remainder of the output was produced by Virginia, Pennsylvania, New Jersey, North Carolina, Maryland, and Georgia.

Imports of talc for consumption in 1925 were 20,993 short tons, valued at $450,532. Corresponding figures for 1924 were 17,809 tons, valued at $342,355.

INCREASED SALT PRODUCTION IN 1925

THE salt produced for sale or use by operators of salt mines, wells, and ponds in the United States in 1925 amounted to 7,397,498 short tons, valued at $26,162,361, according to reports furnished by the producers to the Bureau of Mines, Department of Commerce. These figures show an increase of 9 percent in quantity and 2 percent in value over the figures for 1924, which were 6,803,115 short tons, valued at $25,747,048. The states showing the largest output in 1925 were as follows: Michigan, 2,172,600 tons, valued at $7,710,331; New York, 2,053,966 tons, valued at $7,133,244; Ohio, 1,173,588 tons, valued at $4,116,625; Kansas, 812,539 tons, valued at $2,494,423; and Louisiana, 500,354 tons, valued at $2,218,265.

CARBON BLACK PRODUCTION DECREASES IN 1925

THE production of carbon black in the United States in 1925 amounted to 177,417,378 pounds, according to reports made to the Bureau of Mines from 63 plants operating in eight states. This production is a decrease of 9,454,656 pounds, or 5 percent, from the total output reported in 1924, and marks the first decline in yearly production of carbon black since 1920. On the other hand, deliveries to consumers in 1925 were higher than ever before, the total for the year, 175,631,326 pounds, being an increase over 1924 of 36 percent. This large increase in indicated consumption, despite the decline in production, resulted from a radical change in the situation as regards stocks, which were largely increased in 1924 but which remained steady in 1925.

Although the carbon black industry bettered its position as regards stocks of carbon black in 1925, there was no favorable reaction as to price, which reached a new low level of 5.4 cents as the average per pound at the plant. This compares with 6.2 cents in 1924.

As has been the case for every year since 1921, Louisiana was the leading carbon black producing state, its output in 1925 of nearly 130,000,000 pounds comprising 73 percent of the total for the country. Declines of 28 percent in both West Virginia and Kentucky were recorded in 1925. These declines resulted in the main from a decreased supply of gas, which at the same time became more valuable for other purposes. Perhaps the outstanding event of the year as regards the production of carbon black was the rise to prominence of Texas, which displaced West Virginia as the second most important producing state.

It is estimated that 140,000,000 cubic feet of natural gas was burned for carbon black in 1925 and the average recovery per thousand cubic feet was therefor 1.3 pounds, an increase over 1924. While there is a growing tendency in most producing areas to restrict the supply of natural gas for carbon black, production has not fallen off materially due to improvements in equipment or in operating methods. This has been particularly noticeable in the Monroe field, which supplies all the gas for Louisiana's output.

Exports of carbon black in 1925 amounted to 43,182,635 pounds, which is equivalent to nearly 25 percent of the total production.

ALASKA MINERAL PRODUCTION INCREASES

MINES in Alaska produced $18,220,692 worth of minerals in 1925, as against $17,457,333 worth in 1924, according to an announcement made by the Geological Survey. The total value of the mineral output of the territory since 1880 is $553,304,968.

In spite of the gradual exhaustion of the richer gold-placer deposits, the gold output in 1925 was greater than in 1924, just as the output of 1924 was greater than that of 1923, according to the figures of the Geological Survey. Placer mines produced less gold in 1925 than in 1924, but this decrease was more than made up by the increased production of the gold lodes, which now yield almost as much as the placers.

The production of placer gold from the vicinity of Fairbanks and from Seward Peninsula was reduced to some extent as a result of negotiations and preparation for more active future work by some of the principal operators. Extensive preparation for future mining is being made at Fairbanks and will not be completed for at least two years. As a result of economies and improvements in mining in these two regions, it seems probable that the production of placer gold will be stabilized if not increased. It is of interest to note that the production from dredges in 1925 was greater than in 1924.

Increase in the value of the mineral output of Alaska in 1925, as in 1924, resulted largely from the increase in the value of copper and took place in spite of the fact that less copper was produced in 1925 than in 1924. Following is a tabulation showing the sources of Alaska's mineral output in 1924 and 1925:

MINERAL OUTPUT OF ALASKA, 1924 AND 1925

	1924		1925	
	Quantity	Value	Quantity	Value
Gold, fine ounces	304,072	$6,285,724	307,679	$6,360,281
Copper, pounds	74,074,207	9,703,721	73,855,298	10,361,336
Silver, fine ounces	669,641	448,659	698,259	482,495
Coal, short tons	99,663	559,980	82,868	404,617
Tin, metallic, short tones	7.00	7,028	13.8	15,980
Lead, short tons	631	100,899	789	140,571
Placer platinum metals, fine ounces	21.98	2,594	10.21	1,205
Miscellaneous mineral products, including petroleum, marble, gypsum, quicksilver, and lode platinum metals	.....	348,728	.....	454,207
		$17,457,333		$18,220,692

CRUDE BARYTES AND BARIUM PRODRUCTS IN 1925

STATISTICS compiled from reports made by domestic producers of barytes to the Bureau of Mines show sales amounting to 228,063 short tons, valued at $1,703,097, in 1925—a gain of 16 percent in quantity and 10½ percent in value, as compared with 1924. While the total value of sales increased the average selling value, f. o. b. at mine, dropped from $7.85 to $7.47 a short ton.

Missouri was the largest producer, shipping 44 percent of the country's total output, Georgia ranked second, and Tennessee third.

Crude Barytes Sold by Producers in the United States in 1924 and 1925

State	1924 Short tons	1924 Value	1925 Short tons	1925 Value
Georgia	71,776	$574,208	65,936	$475,618
Missouri	77,189	604,390	101,056	794,927
Tennessee	39,643	302,873	47,012	345,038
Other states*	7,724	59,273	14,059	87,514
	196,332	$1,540,744	228,063	$1,703,097

* 1924: Alabama, Nevada, North Carolina, South Carolina, Virginia, and Wisconsin; 1925: Arizona, Nevada, North Carolina, South Carolina, Virginia, and Wisconsin.

Barium Products Made in the United States from Domestic and Imported Crude Ores and Sold in 1924 and 1925

	1924 Short tons	1924 Value	1925 Short tons	1925 Value
Ground barytes	38,296	$784,881	49,674	$1,040,461
Lithopone	109,469	12,531,397	145,019	15,186,147
Barium chemicals:				
Carbonate	6,058	411,332	4,962	279,346
Chloride	3,859	297,182		
Sulphate (blanc fixe)	7,796	464,152	13,692	928,424
Other*	441	41,234		

* 1924: Hydroxide and sulphide; 1925: Chloride, hydroxide, sulphate, and sulphide.

BARIUM PRODUCTS

Sales of barium products, reported by domestic producers in 1925, amounted to 213,347 short tons, valued at $17,434,378, an increase of 29 percent in quantity and 20 percent in value as compared with sales in 1924.

Nearly 90 percent of the ground barytes sold was manufactured in Missouri. Seven lithopone plants in the Middle Atlantic States and four plants in Illinois were operated during the year. Figures on barium chemicals include only those made directly from barytes or from primary salts of barium produced in the same plant.

INCREASED PRODUCTION OF MICA IN 1925

THE total quantity of uncut mica sold by producers in the United States in 1925, as reported by the Bureau of Mines, was 10,592 short tons, valued at $495,499. Of this quantity 897 tons (1,793,865 pounds), valued at $321,962, was sheet mica; the rest was scrap mica.

The production was made by 12 states, North Carolina, New Hampshire, South Dakota, New Mexico, Virginia, South Carolina, Georgia, Connecticut, Colorado, Alabama, Maine, and Nevada, named in order of total quantity from greatest to least.

DOMESTIC UNCUT MICA SOLD BY PRODUCERS IN THE UNITED STATES IN 1924 AND 1925

	Sheet mica		Scrap mica	
	Pounds	Value	Short tons	Value
North Carolina:				
1924	597,385	$108,656	3,212	$59,620
1925	592,478	105,376	5,095	74,818
New Hampshire:				
1924	744,133	88,737	492	9,498
1925	1,120,857	198,858	1,953	47,525
Other states*:				
1924	119,379	14,642	1,005	18,124
1925	80,530	17,728	2,647	51,194
Total:				
1924	1,460,897	212,035	4,709	87,242
1925	1,793,865	321,962	9,695	173,537

*1924: Alabama, Colorado, Connecticut, Georgia, New Mexico, South Carolina, South Dakota and Virginia; 1925: Alabama, Colorado, Connecticut, Georgia, Maine, Nevada, New Mexico, South Carolina, South Dakota, and Virginia.

The total sales of uncut sheet mica in 1925 showed an increase of 23 percent in quantity and 52 percent in value, as compared with 1924. The total quantity of scrap mica sold was more than twice that of 1924, and the value was nearly twice as much.

The average value per pound of sheet mica sold in the United States in 1925 was about 18 cents, and the average value of scrap mica a short ton was about $18.

The imports of mica for consumption were 4,901,308 pounds, valued at $1,798,827. Corresponding figures for 1924 were 5,801,151 pounds, valued at $2,326,906.

NEWS OF THE MINING FIELD

A Résumé Of The Activities Of The Mining Industry And Items Of Interest In The Field

United Verde Extension Buys Interest in Nichols

United Verde Extension Copper Co., according to reports, has purchased 40 percent of the shares of stock of the Nichols Copper Co. The Katanga Copper Co., it is also reported, has purchased approximately 10,000 shares of the stock of this company. The electrolytic refinery of the Nichols Co. has a capacity for handling 45,000,000 pounds of copper monthly.

Flotation Plant for Big Jim Mines Completed

The Big Jim Mines, Inc., in the Patagonia district of Arizona, of which A. J. Keating, of Los Angeles, and W. J. Loring, of San Francisco, Calif., are president and vice president, has announced the completion of their 75-ton selective flotation plant. A test run of the plant shows an average extraction of 92 percent of the lead and silver values.

Mason Valley Mines Blow In Thompson Smelter

The copper smelter of the Mason Valley Mines Co., at Thompson, two miles from Wabuska, Nev., was blown in August 10 after being idle since 1919. One furnace has been put in operation which will handle about 800 tons of ore per day when running to capacity. It is estimated that there are over 15,000 tons of ore in the smelter stockpiles.

The mines of the company are at Mason, 15 miles south of the smelter. Three hundred tons of mixed carbonate and sulphide ores are being shipped daily from the Bluestone mine. Heavy sulphide ore for fluxing is shipped from the Balakalala mine in Shasta County, Calif., at the rate of 150 tons per day. This property is leased to the Mason Valley Mines Co.

Tonopah Divide to Increase Capital Stock

Stockholders of the Tonopah Divide Mining Co., at a meeting to be held September 20, will vote on a resolution to increase the capital stock of the company from 1,250,000 shares to 2,500,000 shares of $1 par value. The additional stock is to be placed in the treasury to be used as needed, primarily for the purchase of new properties. The company has $140,000 cash in the treasury, which is to be used for operating purposes.

GOLD BEATING PROCESSES ARE DEPICTED AT SESQUI

The ancient processes in the manufacture of gold leaf, which have remained unchanged for the last century, are demonstrated daily at the Sesquicentennial International Exposition in Philadelphia by master artisans of the craft. The material is hammered to the thinness of .003 inch.

James Donnelly, who became an apprentice gold beater in the year of the Centennial Exposition in Philadelphia, a half century ago, may be seen welding an 8-pound hammer which flattens the gold to a transparent thinness. His daughter, Fannie Donnelly, cuts the sheets with a "wagon," makes them perfect with reed pincers, and lays the fluttering leaves between rouged paper, ready for use.

Mine Stripping

According to Skillings Review: "Pickands, Mather & Co., operating agents for the Rogers Brown Ore Co. in the matter of mining the extension of the Kennedy mine ore body under Rabbitt Lake, have for some time been considering the most economical and efficient method of doing so. The property is on the Cuyuna range.

"The original plan was to unwater the lake, but it is a rather large body of water, and the plan now under consideration is to unwater only that part of the lake which is over the ore. The Zenith Dredge Co. of Duluth has been invited to look over the situation and submit estimates for the building of a dyke about that area. The plan is to build the dyke with the material taken from the lake bottom over the ore. In this manner a unique mine stripping feat will be accomplished, the area being relieved of both water and earth overburden. The overburden of earth is from 60 to 80 feet in depth. It is proposed to operate the mine as an open pit to as great a depth as practicable, and then mill the deeper ore. This milled ore could be trammed to the present Kennedy shaft, which is at a considerable distance, or a new shaft could be sunk."

Tonopah Belmont to Start Mill at Hamilton, Nev.

With water supply assured and the 9,400-foot tramway practically completed, the mill of the Tonopah Belmont Development Co., at Hamilton, Nev., was scheduled to start operations late in August. A pipe line is to carry water four and a half miles from the California mill springs to a storage tank. The aerial tramway extends from the portal of the company's Cornell mine to the 75-ton mill, and ore from the Nevada mine will be transported to the tramway through the Cornell haulage tunnel which is being extended to connect with the Nevada workings.

Property to be Developed at Eureka, Utah

The International Smelting Co. will develop its North Lilly property, which consists of 120 acres at Eureka, Utah, the work being done by the Tintic Standard Mining Co.

Tri-State District Mills

The Tri-State Zinc and Lead Ore Producers' Association announce that there are 251 mills in the Joplin-Miami district, practically all of which can be put into immediate operation. There are at the present time 155 concentrators in active operation.

World's Biggest Zinc Mines

The world's biggest zinc mines under one management, says the bulletin of the American Zinc Institute, will result when the Anaconda Copper Mining Co. formally takes over the Polish holdings of the Georg von Giesche heirs. This agreement completes the union of two of the greatest producers, coupling the experience of 222 years of continuous direction with the advantages of modern mass production. The new company will be under American financial and technical direction. The American-Silesian Corporation, as the new firm will be known, will control not only the largest European zinc mines, now furnishing 10 percent of the world production, but will own and operate the famous Blei-Scharley mines, fourth greatest ore body and the world's most extensive high grade zinc ore fields.

BUREAU OF MINES STARTS SURVEY OF MINING AND MILLING METHODS IN MICHIGAN

Exhaustive surveys of milling and deep mine practice have been started in the Michigan copper district by experts of the Bureau of Mines, in cooperation with the mine operators and the Michigan College of Mines.

The survey of deep mining methods will be directed by W. R. Crane, mining engineer, who has devoted much time to that phase of mining. W. H. Coghill, a specialist in concentration, will direct the milling survey.

Mr. Crane came to the Michigan district from Birmingham, Ala., where he made an exhaustive survey of ores and practice. His major study with respect to deep mining in the Michigan district will be the problems of roof supports, settlements and disturbances. Many other allied problems of interest to the industry are expected to develop while the survey is under way. The problem of keeping the workings supported is of vital importance, inasmuch as the Lake Superior district, next to South Africa, has the deepest mines in the world.

Mr. Coghill has made a special study of the concentration problems and practice in the mining industry of the United States. For the last five years he has made his headquarters in the Tri-State district, where he worked out problems of much importance to the lead and zinc industries.

Two other Bureau of Mines experts, D. A. Lyon, supervisor of experiment stations, and A. W. Fahrenwald, a specialist in milling, will come to Michigan later to assist in the research work.

Hecla Declares Dividend

A quarterly dividend of $500,000 equivalent to 50 cents a share on the 1,000,000 shares issued, was recently declared by the Hecla Mining Co. The meeting was held in the Hecla office at Spokane, Wash., and was attended by James F. McCarthy, president; Clarence F. Kipp of Milwaukee, Wis., and others. Payment will be made on September 15 to stockholders of record on August 15.

The forthcoming disbursement will increase the payments for the year to $1,500,000, the other two having paid for a long period. It will increase the grand total to $15,605,000.

"Ore is being raised from the mine at the rate of 900 tons daily," said President McCarthy. "Of this quantity 200 tons are taken out in sorting and 700 tons are sent to the mill.

"Drifts have been run on the 2,400-foot level for about 500 feet and on the 2,800 for 600 feet. The conditions are good. The drifts are in ore, but we are not carrying them to the full width of the body. There are places where we have crosscut ore for 24 to 25 feet, but we do not expect the body to have that width throughout its length."

The 2,400 and 2,800 are development levels, no ore being taken from them except that broken in the course of drifting and then to make room for the operations. Stoping is done on the levels above them. The concentrating mill of the Hecla is at Gem, two miles from Burke. Containing lead and silver the ore is treated in the Bunker Hill smelter at Kellogg.

Improvements at the Hecla, located at Burke, Idaho, in the Coeur d'Alene mining region, include a bin that will have a capacity of 2,000 tons and be used in the storage of ore from the Star mine, in which the Hecla has a half interest. An addition is being made and equipment installed that will double the capacity of the change room. With 600 employed this room was congested, although built since the fire that swept the plant two or three years ago. Like all others of its structures the additions will be fireproof.

Ahumada Lead Report

Ahumada Lead Co. reports for six months ended June 30, 1926, net income of $597,523 after depreciation, taxes, etc., equivalent to 50 cents a share (par $1) earned on 1,192,018 shares of capital stock. This compares with $762,515 or 64 cents a share in first half of 1925.

Net income for second quarter of 1926, was $233,680, equal to 19 cents a share, comparing with $363,837 or 36 cents a share in preceding quarter and $339,869 or 28 cents a share in second quarter of previous year.

Utah Copper Co. Output Higher With Costs Reduced

Utah Copper Co. for the second quarter of the fiscal and calendar year 1926 reports the total net production of copper from all sources as shown below, in comparison with the output for the first quarterly period of 1926:

	Net Pounds Cop. Produced	Average Monthly Production
1926—2d quarter	53,780,647	17,926,882
1926—1st quarter	53,472,436	17,824,145

The average grade of ore treated at the mills was .99 percent copper, and the average mill recovery of copper in the form of concentrates was 87.92 percent of that contained in the ore, as compared with 1.01 percent copper and 88.72 percent recovery, respectively, for the previous quarter.

The average cost per pound of net copper produced, including depreciation of plant and equipment and all fixed and general expenses, and after crediting gold, silver and miscellaneous earnings, was 8.5 cents, as compared with 8.9 cents for the preceding quarter computed on the same basis.

Quarterly Report of Nevada Con.

Statement of Nevada Consolidated Copper Co. and subsidiaries, including Ray Consolidated Copper Co., for quarter ended June 30, 1926, shows profit of $1,720,121 after ordinary taxes and depreciation, but before depletion and Federal taxes. Figuring on 5,076,636 no par shares which would be outstanding if all Ray and Chino shares were exchanged for Nevada stock, the above profit would be equivalent to 33 cents a share, and compares with $1,862,448, or 36 cents a share, in preceding quarter. For first six months of this year, profit totaled $3,582,569 equal to 70 cents a share on the above basis.

Star Mine Shipments

Shipments from the Star mine of the Sullivan Mining Co. are proceeding to the Bunker Hill mill at the rate of 400 tons daily, according to James F. McCarthy, president. It is broken in the course of development, hauled through an 8,000-foot tunnel and raised from the 2,000-foot level of the Hecla mine to the surface. The zinc concentrate is shipped to Belgium and the lead taken to the Bunker Hill smelter. A drift is proceeding on the 3,500-foot level of the Star, the third level opened since the long tunnel was driven from the Hecla. It has been run for about 700 feet and is making a good showing of ore. The drift lacks about 900 feet of its objective, a point near the Morning line of the Federal Mining and Smelting Co.

The Sullivan Mining Co. is owned equally by the Hecla Mining Co. and the Bunker Hill and Sullivan Mining and Concentrating Co.

Copper Production

Production of copper from United States mines in July was 72,949 short tons compared with 70,632 tons in June, 73,542 tons in May and 73,454 tons in April, making 505,462 tons produced by United States mines in first seven months according to American Bureau of Metal Statistics. This is an average of 72,209 tons a month or 2,384 tons a day compared with monthly average of 70,176 tons and daily average of 2,307 for full year 1925 and 66,115 and 2,168 tons respectively in 1924. Increase in output in July was due to increase in production at the so-called porphyry mines.

Silver Imports and Exports

In view of the possibilities of the Indian silver reserve being sold in the market in connection with proposed adoption of gold standard by the Government of India, recent movement of silver in the United States to date is of interest. For seven months ended with July balance of exports was $14,353,745 against a balance of exports in corresponding period of 1925 of $21,444,000.

Imports and exports of silver for July and the seven months with balance of exports are shown as follows:

	Exports	Imports	Bal. of Exp'ts
July, 1926 ..	$7,920,279	$5,948,630	$1,971,649
July, 1925 ..	8,349,000	5,238,000	3,111,000
7 mos. 1926 .	57,289,460	42,935,715	14,353,745
7 mos. 1925 .	58,864,000	37,420,000	21,444,000

Silver exports from the United States to British India in past five years have been as follows: 1921, $3,233,382; 1922, $11,971,351; 1923, $23,720,929; 1924, $54,118,562 and 1925, $47,193,355.

A Big Mineral County

Mine production of all counties in Washington recently made public in figures released through the Department of Commerce, Washington, D. C., gives Stevens County one of the big producers of the state.

The state produced 11,138.49 fine ounces of gold in 1925, as compared to 14,977.72 in 1924; silver records show 166,425 ounces of silver produced in 1925 as compared to 213,742 in 1924; copper, 1,159,057 pounds as compared to 928,458 in 1924; lead, 5,627,241 as compared to 3,935,376 pounds in 1924; and zinc, 1,217,846 pounds as compared to 910,890 in 1924.

Total value of minerals mined in 1925 was $1,092,464 as compared with $948,490 in 1924.

Ferry County led in gold production. Stevens in silver, Snohomish in copper and Stevens in both lead and zinc.

DR. SMITH REPORTS ON TRIP

In a report to the Secretary of the Interior upon a five-week trip throughout the West, Dr. George Otis Smith said:

"If I were to select from my observations and impressions on this inspection trip what appears to me to have most significance, it would be the more receptive attitude of the industrial leaders toward new ideas and new ways of doing things. In academic circles this is called the research attitude, but in the field it is more the determined effort to lower costs. The adoption of loading machinery is cutting down the cost of coal to unexpected levels, the expansion of the power systems is likewise lowering the cost of electricity and broadening the fields of its usefulness, and the executives who control the destinies of the larger oil companies are giving more enthusiastic support to their engineering staffs—and all this means to me that practical conservation is winning out in the use of all the great stores of natural resources in the western country."

Resources of National Banks

Total resources of the 7,978 national banks in the United States, Alaska and Hawaii on June 30, the close of the fiscal year, aggregated $25,315,624,000, an increase of almost $1,000,000,000 over a year ago, it was reported by the Comptroller of the Currency.

Total resources were $24,893,665,000 on April 12, the date of the last national bank call, and $24,350,863,000 on June 30, 1925.

Loans and discounts, including rediscounts, amounted to $13,417,674,000 on June 30 this year. This was $116,368,000 more than in April and $743,607,000 more than a year ago.

Percentage of loans and discounts to total deposits was 65, compared with 65.93 on April 12 and 63.66 on June 30, a year ago.

Cash in the banks totaled $359,951,000, a decrease of $7,622,000 since April, but an increase of $346,000 over June of last year.

Total deposit liabilities were $20,642,164,000, an increase of $466,366,000 over April and $732,495,000 over June of last year.

Imports of British Ferro Decrease

The heavy sales of domestic ferro-manganese, which were made late in 1925, naturally reduced the amount of British alloy which would usually come to this country. This fact is clearly reflected in the data for this year, which show a marked decrease in the exports of ferro-alloys from Great Britain. The actual figures are shown by the following table:

	Total	Per month
6 months, 1926	20,514	3,419
6 months, 1925	62,273	10,879
1925, year	95,483	7,957
1924, year	57,987	4,832

According to this data, the exports of ferro-alloys, which were largely ferro-managanese, were only 3,400 tons per month for the first six months as compared with about 10,800 tons per month for corresponding six months last year.

Actual exports to United States for the first half of this year have been 11,504 tons against 40,554 tons for the same six months in 1925. In 1925 the rate of exports was 7,957 tons per month to the United States, showing that the movement this year is less than half of what it was a year ago. This is due, of course, to the fact that British sellers have been unsuccessful in competing with the American and foreign electric furnace made products. The coal strike has also interfered with production as well as shipments.

The Use of Lead in Storage Batteries

According to a statement published in the *Joplin Globe*, something like 175,000 tons of lead are used each year in making batteries for automobiles. Their statement is as follows:

"It is estimated there are some 20,000,000 automobiles in the United States equipped with a battery. Each battery contains on an average of 32 pounds of lead. It is also estimated the average life of a battery is two years, so that something like 175,000 tons of lead a year is used in making batteries. But what becomes of this lead after the battery is replaced?

"A trip to the Ontario plant of the Eagle-Pitcher Lead Co. will answer that question. At the present time the company has more than 1,500 tons of old battery plates. The Ontario plant is operated part of the time on scrap lead and part of the time on lead concentrates, according to A. J. Smith, general manager. The scrap lead, composed chiefly of battery plates, is allowed to accumulate until they have from 1,000 to 3,000 tons on hand.

"Antimonial lead and soft pig lead is made at the Ontario plant. Both products are of the highest grade and are shipped to all parts of the United States."

Consolidation to Spend $2,500,000 on Improvements

Plans have been approved by the executive committee of the Consolidation Coal Co. for an improvement and development program in the Fairmont, W. Va., region which calls for the expenditure of approximately $2,500,000 in the near future.

The basis of the plan is a desire to concentrate production at 10 or more plants in the Monongahela Valley, but at the same time it is stated that all of the property of the company will be benefited and some of the older mining plants and settlements will be virtually made over. In many instances the older dwellings of miners, as well as company buildings, will be torn down, roads will be improved, sidewalks constructed, attractive fences built, greater drainage and other sanitary measures taken, electric lights and running water installed, and in addition to that a number of new homes for miners will be built. At all the plants in Marion and Harrison Counties the living conditions of the employes will be improved and their surroundings made more attractive. Responsibility for executing the new program will rest to great extent upon the newly created department of allied operations, of which Brooks Fleming, Jr., is the head.

It is the intention of the management to provide equipment and facilities for the production of at least 25,000 tons of coal a day in the Fairmont field. The company is now said to be turning out more coal at its New England, Shaft, Baxter, Monongah, Carolina, Owens, Idamay, Wyatt, Ehlen, Gypsy and Pinnickinnick mines than was produced in 1911 when 42 Consolidation plants were in operation in the Monongahela Valley.

Many improvements will be made underground, including heavier rails and flame proof equipment, new tipples already having been authorized for the Owens and Pinnickinnick mines.

The present is the first general development program which the Consolidation Coal Co. has embarked upon in the Monongahela Valley since the World War, and is generally regarded as an indication of the faith of the company in the northern West Virginia region. Col. C. W. Watson, president of the company, intends to remain in northern West Virginia for some time in order to give attention to the details of the new program.

Goes to O'Gara Coal Co.

Cecil W. Smith, who has since 1918 been associated with the Illinois Coal Corporation, has been appointed assistant general manager of the O'Gara Coal Co., with headquarters at Chicago.

ANTHRACITE EXHIBIT AT SESQUI

Practically all the material for the exhibits of the anthracite industry at the Sesquicentennial Exposition are on the ground awaiting installation. The exhibit will be housed in building No. 5, the Palace of Mines, Metallurgy and Machinery. Part of the exhibit will consist of eight large oil paintings, showing every phase of hard coal mining according to the artist's conception, and all are faithful to conditions of work in the hard coal field.

One exhibit is a mine car loaded with coal just as it was dug, with sand, rock, slate and other impurities. A miniature breaker will show the process of manufacturing and refining the coal, and this is expected to disabuse the minds of many people of the prevalent idea that anthracite is simply dug from the ground and sold.

The main feature of the exhibit will be sculptured representations of actual work in a mine, the figures being very lifelike and the result of long and intimate study of the miners and operations in a colliery.

Those in charge of the exhibit are facing some difficulty in the transportation from the mines of a 3-ton lump of coal, which is to be set up in the building. The three large cubes of virgin coal bearing the dates, 1826, 1876, and 1926, to show the progress of the industry since its foundation, are on their way. Modern coal pockets and equipment for the retailer will also be shown in miniature, and there will be plenty of anthracite literature on hand, while an anthracite engineer will explain all about the industry.

Purchase Interests of John Markle

Negotiations have been completed for the purchase of the interests of John Markle, in the Jeddo Highland Coal Co., by Alvan Markle, Jr., E. B. Markle and Donald Markle, sons of Alvan Markle, Sr., of Hazleton. The company is one of the largest independent anthracite producing companies in the hard coal fields.

Reopen Elm Grove Mines

The Elm Grove Mining Co., owned by the Paisley interests, has resumed operation of its No. 2 mine at Triadelphia, after an idleness lasting since early last spring when a disagreement with the United Mine Workers closed the property. It is announced that the company will resume operation at the fourth mine at Elm Grove, September 1.

Island Creek Makes Gain

The recent report of the Island Creek Coal Co. for the six months period ending June 30, 1926, shows a net profit of $1,417,497. This after deductions have been made for depreciation, depletion, Federal taxes, and dividend requirements.

Reforesting Strip Land

The Big Four Railroad, in cooperation with the Enos Coal Mining Co., has started a reforestation plan in Pike County, Ind., where they will reclaim thousands of acres of land stripped of coal, by planting forests thereon. Two thousand trees already have been planted, and this is but the beginning of the work.

Anthracite Tax Shows Decided Decline

S. S. Lewis, state treasurer for Pennsylvania, recently announced that the coal strike of last year is definitely reflected in the amount of tax returned by the anthracite producers for the year 1925. His statement shows a decrease of approximately $500,000 in the tax paid by six of the larger coal companies. He estimates that the decrease in this year's return will be approximately 33 1-3 percent from the return of last years.

Proposed Coal Classification

The committee appointed by the Coal Mining Institute of America to study the question of coal classification has made its recommendations to The American Engineering Standards Committee, which are embodied in a letter to that organization, which is as follows:

"The undersigned were appointed a committee of the Coal Mining Institute of America to bring before your American Engineering Standards Committee the subject of a proposed coal classification. We hardly need to call your attention to the desirability of some such classification, alike to producers, buyers, sellers and consumers.

"It was the belief of the Coal Mining Institute of America that the classification here submitted contained at least the basis of a satisfactory code, and that the best way to introduce it, or possibly a modification of it, to the coal world, would be to secure the approval of your committee.

"The classification, therefore, is submitted for consideration by your committee, with the understanding that it is only a proposal, subject to such modification or revision as may seem desirable.

"The writers will be glad to meet with the members of your committee at any time you may set. The scheme is sub-

mitted in the belief that it reduces to its simplest elements what is in appearance a complex subject.

"There has been a growing feeling intensified during and since the war that a simple, definite classification of coal would aid greatly in the purchase and sale and use of coal. There is today widespread agreement on the general character of coals produced in different regions or needed for different uses. All that appears to be needed is agreement on different limits for separating one class from another, and names that will go with and are generally recognized as applying only to coals within such accepted limits.

"While certain differences of coals are obvious to the eye, experience has shown that the needs of today demand finer distinctions than can be observed without chemical or physical tests. At the same time, to meet the needs of the practical man, these tests must be reduced to those most readily made and understood.

"Most of the schemes presented in the past have required the making of costly ultimate analyses of the coal and have failed to take account of physical characters that today may influence the behavior of the coal in use as much or more than its chemical character. Moreover, some of the most acceptable of the schemes (such as the use of fuel ratio) apply to only a limited range of coals, and fail entirely outside of that range.

"It is believed that the plan of classification herewith presented is both the simplest and most comprehensive that has yet been offered. Chemically it calls for only the determination of ash and fixed carbon (sulphur and fusion temperature of ash are required in certain instances). In a few instances a test to determine caking character is required. The general scheme, however, is based on one figure—the percentage of fixed carbon in the ash-free, moisture-containing coal.

"In order that a person using the plan may indicate the basis of his classification of the coal it will be necesasry to append some designation for the plan, or, better still, to use new names for the coal, the use of such names in themselves implying the use of the specific limits herein given. Associated with the plan are, therefore, given a set of simple names (actually abbreviations of common trade names).

"Tests covering many years, using every possible element or combination of elements of coal, pointed to the percentage of fixed carbon in the "as received" sample reduced to the ash-free basis, as giving the widest range of values allowing the ready separation of all coals of similar physical character from anthracite to lignite. Furthermore, it was found that coals commonly separated in market reports or priced differently because of heating value fell naturally into groups separated typically by differences of "fixed carbon" of about 7 percent. This discovery was made use of in simplifying the plan by separating the several classes of coal uniformly by 7 percent of fixed carbon. Coal 70 thus became a coal having 70-77 percent of fixed carbon on the as-received, ashfree basis; all of the coals bear names which are multiples of seven—28, 35, 42, 49, 56, 63, 70, 77, 84.

"To this simple name letters are added to distinguish differences in ash and sulphur content or to distinguish physical differences. That is the whole plan.

"For example, eastern United States coals are divided as follows:

TABLE OF EASTERN COALS

	Fixed carbon	Name
Anthracite, hard	89 plus	Coal 89
Anthracite, soft	84-89	Coal 84
"Admiralty," "smokeless," coal	77-84	Coal 77
Low volatile coal (Clearfield)	70-77	Coal 70
Medium volatile coal (Connellsville)	63-70	Coal 63
High volatile coal (Pittsburgh	56-63	Coal 56
Higher volatile coal (S. Ill.)	49-56	Coal 49
High moisture, bit. coal (N. Ill.)	42-49	Coal 42

"Subbituminous coal mostly falls in coal 35 and lignite in coal 28. The ash content is indicated by the use of A, B, C, D after the name of the coal to distinguish four grades. K signifies cannel coal, and so on. The plan as here presented differs from previous presentations of the same plan as the result of conferences by a committee of the Coal Mining Institute of America. Otherwise it may be compared with the other schemes that have been presented in the chapter on "Coal Classification" in "Coal," by Ellwood S. Moore; and in "Fuels and Their Combustion," by Robert T. Haslam and Robert P. Russell.

"Yours very truly,

"(Signed) GEO. H. ASHLEY.

"(Signed) W. E. FOHL."

Coal Rates Upheld

Examiner William A. Disque, of the Interstate Commerce Commission, has recommended to the commission that the rate on bituminous coal in car load lots from Illinois and Indiana mines to the Chicago district and territory in the west and northwest were not unreasonable. Coal operators from the Indiana and Illinois fields, complained that the rate structure was one cause of their inability to compete successfully with coal from Western Kentucky and Pennsylvania, Virginia, West Virginia and Tennessee fields. The examiner admitted the poor condition of the industry in the state protesting, but pointed out that the wages paid in these fields are higher than in the competing fields mentioned.

American Metal's Case

United States District Attorney Buckner in United States District Court, New York, has filed a dismissal of the indictment brought October 25, 1925, which charged a $7,000,000 fraud against the Government in the disposition of the assets of the alien-owned American Metal Co.

Mr. Buckner not only announced his conviction that no fraud in that amount had been committed, but in effect exonerated the foreign corporations and their officials named in the indictment of wrongdoing. He asserted, however, "that through the transaction the Government had been defrauded out of the unbiased and unprejudiced services" of Col. Thomas W. Miller, Alien Property Custodian at that time, and Harry M. Daugherty, then Attorney General, "because of the manner in which the claim was allowed, and because the compensation they received from the late John T. King for allowing it."

He announced that trial of a second indictment brought against Colonel Miller and Mr. Daugherty on May 7, last, along these lines, which he called "the proper indictment," has been set for September 7.

The American Metal Co. was taken over by A. Mitchell Palmer, as Alien Property Custodian, shortly after this country entered the war, on the ground that it was enemy owned. The 1925 indictment grew out of Colonel Miller's subsequent allowance of a claim submitted by foreign capitalists through which they recovered $7,000,000 in cash and Liberty bonds, representing proceeds of the sale by the Government of the American Metal Co.'s assets.

Illegal Mining on Public Lands

President Coolidge recently approved the enactment of the following law, dealing with the illegal removal of coal from public lands:

"That it shall be unlawful to mine and remove coal of any character whether anthracite, bituminous, or lignite, from beds or deposits in lands of the United States, or in deposits or beds reserved to the United States, with the intent wrongfully to appropriate, sell, or dispose of the same, and every person who shall violate any of the provisions of this act shall be deemed guilty of misdemeanor and fined not more than $1,000 or imprisoned not more than one year, or both. Nothing in this act, however, shall interfere with any right or privilege conferred by existing laws of the United States."

The Canadian National Railways has issued a pamphlet containing maps and information as aids to development of mineral resources along its lines in northeastern Canada.

Annual Safety Meeting

The seventh annual meeting of the Lake Superior Mining Section of the National Safety Council was held at Ironwood, Mich., August 19-20. The following papers were presented:

"What Accident Prevention Means and What's Doing in Safety," H. G. Hensel, safety director, the Youngstown Sheet & Tube Co., Chicago, Ill.; "Accident Prevention As I See It From the Workman's Standpoint," Carl Young, commissioner, Dept. of Labor & Industry, Lansing, Mich.; "Interesting Eye Injuries from the Viewpoint of Compensation Payment," B. T. Larson, Ironwood.

"Public Safety," Rev. Axel Pearson, Ironwood; "The Duties of the Employer, the Foreman, and the Workers in Accident Prevention," R. C. Knutson, Commissioner Industrial Commission of Wisconsin, Madison, Wis.; "Good Housekeeping in Mine Operations," F. C. Gregory, District Engineer, United States Bureau of Mines, Duluth, Minn.; "Mine Haulage with Storage Battery Locomotives," J. M. Cunningham, Jr., Mancha Storage Battery Locomotive Co., St. Louis, Mo.

"Construction, Machine and Mental," F. C. Blake, field representative, Industrial Commission of Minnesota, Duluth, Minn.; "Prizes and Bonuses in Safety Work," G. E. Burns, safety engineer, National Safety Council, Chicago, Ill.; "Hoisting Cables," A. J. Morgan, Engineering Dept., John A. Roebling's Sons Co., Chicago, Ill.

A business session followed the papers and a lunch was served at the Elks Club. Delegates visited mines on the Gogebic iron range.

To Erect Mine for Rescue Work

Contracts for the building of a miniature mine to be used in connection with the international mine rescue contest to be held at the Greek Theater, Berkeley, Calif., on September 4, have been let, according to Byron O. Pickard, district engineer for the United States Bureau of Mines. The setting for the rescue contests will represent the longitudinal section of a mine and from the open side the rescue work may be viewed by the audience.

The miniature mine is to be erected at a cost of approximately $1,500 and teams from all parts of the United States, British Columbia and Mexico will compete. The contest is one of the features of the Third Pacific Coast Safety Conference to be held in San Francisco. Three safety projects are being combined into one event to give the bay region one of the largest safety meetings ever held according to Pickard, who is assisting with the arrangements.

With the Pacific Coast Safety Conference will be combined the mine rescue and first aid contest and the fourth annual California industrial first aid contest.

Five mine rescue teams from Illinois are the most recent entries in the contest which is expected to attract nation-wide attention. The contest will be open to the public and will be held from 9 until 12 on the morning of September 4.

Frank C. Gregory, formerly an assistant at the Bureau of Mines in California, is coming from Duluth to personally direct the mine rescue contest. The judges will include men versed in mine rescue work.

Annual Meeting A. I. M. E.

First announcements have been sent the mining industry for the annual general meeting, its 134th, of the American Institute of Mining and Metallurgical Engineers, at Pittsburgh, Pa., Oct. 6-9, 1926. According to the announcement an unusual series of meetings has been arranged for the fall of this year. The regional meeting to be held at Denver, Colo., in conjunction with the annual meeting of the Western Division of The American Mining Congress, will be the first of these meetings to be held. The Pittsburgh meeting will discuss subjects relating to coal, iron and steel, and natural gas. The meeting will be held at the Hotel Schenley. On Tuesday, October 5, there will be held a round-table discussion on the Combustibility of Coke, Methods of Testing Coke, and Open Hearth Conferences. On Wednesday, October 6, President S. A. Taylor will deliver an address, with response by Julian Kennedy, and the technical sessions will discuss coal and coke, and iron and steel problems. On Thursday, October 7, an all day boat trip up the Monongahela River will be taken, and a stop will be made at the plant of the National Tube Works, at McKeesport, and at the Carnegie Steel Co. Friday, October 8, will be devoted to a discussion of technical papers, and Saturday, October 9, will be devoted to a group of trips, any one of which will be delightful. Full information concerning the meeting may be obtained by addressing the Institute at 29 West Thirty-ninth Street, New York City.

President Hotchkiss Inaugurated

During the Michigan College of Mines reunion at Houghton, Mich., Dr. W. O. Hotchkiss was, on August 13, inaugurated as president of the college. Dr. Hotchkiss has held this office since last September, when he was appointed to succeed the late Dr. F. W. McNair. He is the third president to come to the college in its 40 years of existence.

International Mid-Continent Engineering Convention

The Second International Mid-Continent Enginering Convention was held at Duluth, Minn., August 12, 13, 14, and the Minnesota Federation of Architectural and Engineering Societies cooperated with it in making it a success. The attendance was estimated to be 500. The convention was held at the Hotel Duluth, the Duluth Engineers Club and the Engineers Club of Northern Minnesota acting as hosts. The following papers were presented: "Iron Ore Transportation," by W. H. Goyt, chief engineer Duluth, Missabe and Northern Railway; "Iron Ore Situation," by W. G. Swart, vice president and general manager, Mesabi Iron Co.; "The History and Development of Diamond Drilling," by S. E. Atkins, president of S. E. Atkins Co.; "An Application of Aerial Photography to Map Making," by Lieut. E. G. Plank, Corps of Engineers, United States Army.

Ohio Mine Workers Decline Invitation of Operators' Association to Consider Wage Scale

Another move by coal operators for a readjustment of the wage scale fell short when Lee Hall, president of the United Mine Workers of Ohio, refused the request of the newly organized Ohio Coal Operators' Association to attend a meeting August 24 at Columbus for the purpose of considering a scale of wages on which the idle mines of Ohio could be opened. Mr. Hall stated that there is no need for a discussion of wages at this time, as the Jacksonville agreement does not expire until March 31, 1927.

At the meeting of the executive officers and board of directors of the operators' association, held at Columbus on August 10, careful consideration was given to the present state of the industry in Ohio, and ways and means were discussed for rehabilitation. It was determined after due consideration, to request the executive officers of the Ohio United Mine Workers to call a meeting of the Mine Workers to meet in joint convention with the operators August 24. The following letter was sent to the president of District No. 6, Ohio United Mine Workers of America:

"At a meeting of our association today, we are instructed to request you, as president of District No. 6, United Mine Workers of America, to call a meeting of the Mine Workers of the State of Ohio, in joint convention with the Operators of the State of Ohio, at the Neil House, Columbus, Ohio, at 10 o'clock a. m., August 24, 1926, for the purpose of considering a scale of wages on which the idle mines of Ohio may be reopened.

"Will you please advise promptly if you will arrange with your membership

for such a meeting, directing your reply to S. H. Robbins, president, Cleveland, Ohio, and sending a copy to J. S. Jones, secretary of the association, Columbus, Ohio.

"Very truly yours,
"S. H. ROBBINS, *President.*
"JOHN S. JONES, *Secretary.*"

Since that time Mr. Hall made a tour of the principal mining sections of the state, sounding the sentiment of the district officials on which he wished to base his reply to the operators. He also conferred with other international officials at Indianapolis, and it is apparent that what he learned from these sources was of such a nature as to cause his determination to keep the miners' officials out of conference with the operators.

Defends Jacksonville Scale

Unless the United Mine Workers of America agree to an amicable arrangement when they meet the bituminous coal operators in Miami in January to write a new contract replacing the Jacksonville agreement expiring next April, the union will be destroyed, declared Eugene McAuliffe, of Omaha, president of the Union Pacific Coal Co., at the recent meeting of the Institute of Politics.

Mr. McAuliffe, one of the largest individual coal operators in the country, asserted that the great increase in non-union production would tend toward destruction of the union unless the organization entered upon a new policy based on cooperation with the operators and on the approval of the use of machinery.

Increased mechanization of the mines has been retarded because of the activities of the union and the indifference of the operators. He said that during the life of the Jacksonville agreement, which went into effect April 1, 1924, soft coal production by union miners has fallen from 78 percent of the Nation's total to 30 percent.

Mr. McAuliffe defended the Jacksonville agreement as "one of the most constructive pieces of work done in industry in recent years," but it was attacked by William W. Tracy, of the Sangamon Coal Co., Springfield, Ill., and C. B. Huntress, of the National Coal Association.

Brophy and Sneed Would Succeed Lewis

John Brophy, president of District No. 2, United Mine Workers, and William J. Sneed, member of the executive board of the tenth Illinois subdistrict, have announced their candidacies for the office of International President of the United Mine Workers of America at the election that will be held in December.

Mr. Brophy's announcement was made from the district offices at Clearfield, Pa., and states that he is a candidate in response to the urging of a large number of the members of the miners' organization. His platform calls for the organization of the non-union fields and the nationalization of the coal industry.

For the past six years Mr. Sneed has represented the Williamson County miners' district in the state senate.

TRADE UNION ORGANIZATION

The extent of trade-union organizations in the United States is shown in a recent survey by the United States Bureau of Labor Statistics, a summary of which is published in the August issue of the Monthly Labor Review. The total number of members of all labor organizations at the time the study was made was 4,443,523 of whom 3,383,997 were in organizations affiliated with the American Federation of Labor and the remainder in independent unions. The survey also covers the history, form of government, jurisdictional boundaries, and benevolent activities of the different organizations.

Saving by Use of Electricity

A Butte, Mont., dispatch states that a large saving is being effected by use of electric power as compared with steam power in mines of Anaconda Copper Mining Co. Montana Power Co., a few years ago offered to replace 75,000 horsepower generated by steam at a cost of $125 per year per horsepower with 75,000 hydro-electric horsepower at a cost of from $35 to $50. Company is saving $2,000,000, which is equivalent to 50 cents a ton in operations. This saving enables company to mine ore averaging 6 pounds less of copper per ton than could otherwise have been mined at a profit. It increases commercial ore which otherwise would have been rejected, and which, owing to mining conditions, would be lost forever.

Research Fellowship at Carnegie

Thirteen graduates of colleges and universities have been appointed research fellows to conduct an unusually extensive program of studies in mining and metallurgy at the Carnegie Institute of Technology during the coming year. The work, as in the past, will be carried on by the Department of Mining and Metallurgical Engineering, in cooperation with the Pittsburgh station of the United States Bureau of Mines and under the direction of two advisory boards of engineers and business men representing the mining and metallurgical industries.

The appointees and the institutions from which they were graduated are: Clarence L. Corban and G. R. Fitterer, Rose Polytechnic Institute; Briant F. Branting, University of Utah; R. L. Geruso, Rensselaer Polytechnic Institute; Charles H. Gilmour, Syracuse University; E. R. Perry, Hastings College; Miles B. Royer, Pennsylvania State College; E. J. Talbert, University of New Hampshire; N. A. Tolch, University of Illinois; Carl E. Traubert, University of Denver; Stanley P. Watkins, Birmingham Southern College; R. E. Wiley, University of Minnesota; Donald C. Jones, Carnegie Institute of Technology.

Of the 13 investigators, 5 will study problems in metallurgy and 8 have been assigned to carry on research in problems relating to coal mine engineering. The program of metallurgical studies will be supervised officially by an advisory board of Pittsburgh district steel men and engineers and the coal mining investigations by an advisory board of coal operators and mining engineers.

Four of the studies, it is announced, will be financed by the Carnegie Institue of Technology, while the remainder of the work will be underwritten by the industries. Among the contributors are the American Gas Association, which is interested directly in a study of "warning agents for manufactured gas"; the National Coal Association; the New York Edison Co.; and other industries.

MARKETING COMPLEX ORE PRODUCTS

(*Continued from page* 650)

complex, and being modern compounds each has its own peculiarities to be fitted to or in with the reduction methods which age has standardized. However, there is flexibility in each stage of the art which can be commercially interlaced with advantages to both.

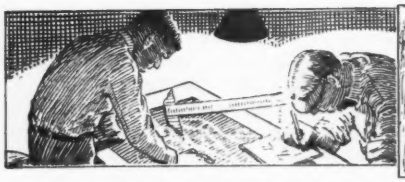
While there are many microscopic features to be finally considered in improving margins, there is reason to harmonize the readily visible factors of margin making and sharing.

GAS MASKS AND RESPIRATORS

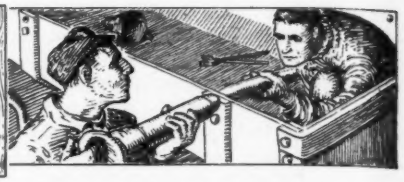
(*Continued from page* 673)

or supplementary equipment and to have on hand for immediate emergency use.

When the precautions, before enumerated, are observed the mask can be a valuable protective equipment for mine use, as has been demonstrated by its successful and safe use in fire control and recovery work following explosions in over 200 cases that we have record of, and over 2,000 are now installed in the mines in this country, and many in foreign countries.



WITH THE MANUFACTURERS



New Breaker Localizes Feeder Outages

A new single pole circuit-breaker just announced by the Ohio Brass Company is a combination circuit-breaker and single-pole switch completely enclosed in an insulating case.

It is a device for sectionalizing power and trolley circuits at butt headings, the entrance of each of a group of small mines working from one powerhouse, or for any distribution arrangement where a branch circuit handles current for a number of locomotives. The use of such a switch properly located prevents local overload or short circuit conditions from interrupting the whole power system, as is the case if the main circuit-breaker in the powerhouse is the only protection.

With this device the overload is placed closed to the point of use of the electric power and it can be set to protect the motors and cables affected more accurately and certainly.

The normal rating of this device is 500 amperes, and it permits an intermittent overload of 50 percent. The overload current trip is made by means of an armature actuated by the excessive current in the trip coil. Adjustment between 200 and 800 amperes is provided by a spring setting on the armature.

The O-B circuit-breaker completely cuts off current and voltage. It is opened by overload or manual tripping; it will not reclose itself unless the operator throws the handle to the connection position. The breaker does not have low voltage protection; in other words, in case of failure of voltage from the power side, it will not automatically open. In such cases return of the power will find the breaker still closed and energy available out at the end of the line.

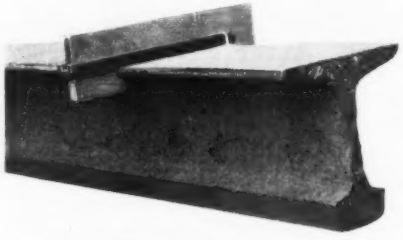
The mechanism is entirely enclosed in a case made of Dirigo molded insulation. The operating handle is soft rubber. The mechanism consists of a single-pole circuit-breaker contactor and a single-pole knift switch, the two being connected in series. They are both arranged to be operated from the same handle, and are so interlocked mechanically and electrically that their sequence of action is always such as to make and break the current on the breaker contacts and not on the knife switch.

This new breaker can also be used for protection of mine locomotive motors by installing a breaker on each locomotive and setting it to trip at a predetermined current valve.

A New Design of Rail Anchor

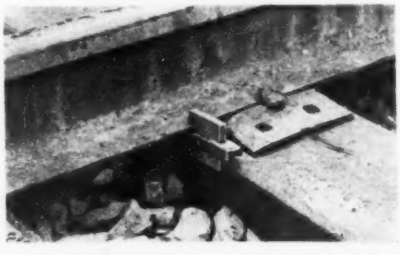
The "Bethco" Rail Anchor has recently been put upon the market by Bethlehem Steel Co. The outstanding features of this anchor are sufficient adjustment to fit rails in any condition, and an original design which prevents the two parts of the anchor from being separated.

While the anchor is of two-piece construction, it is shipped and installed as



one piece. The two pieces can only be separated with considerable difficulty and by a very unusual manipulation of the parts. This two-piece construction allows sufficient adjustability to take care of more than one rail section, over or undersize rails, and the increasing tendency of rails to wear thin where they rest on the tie plates or because of corrosion.

The anchor consists of a heavy flat yoke which hooks over the base of the rail on both ends and a heavy key which is driven horizontally between the base of the rail and the yoke. This key provides the wedging action to hold the rail in place and can only be removed in a similar manner to the way it is installed. Since there is no force acting upon the key in this direction it will not become loosened while in service. The wedging action of the key is crosswise of the rail, along practically the entire base of the rail. This fact, and the channel shape of



the key prevent it from being forced sidewise off the yoke.

The working forces are exerted against the anchor at right angles to the yoke and key. The deep, broad surface of the yoke, along its entire length, bears against the surface of the tie, distributing the pressure over a large area, avoiding damage or destruction to the tie.

The installation of the anchor is extremely simple. The yoke is hooked over the base of the rail and the key is driven home by means of a hammer, rail chisel or other handy tool. No special tools are required. Since the key cannot be dislodged except by driving, no further attention is required until renewal of the ties or other work makes the removal of the anchor necessary. Slippage of the rail through the anchor can only be accomplished by practically destroying it.

The anchor meets all the specifications of the A. R. E. A. requirements for rail anchors or anti-creepers.

Bethlehem Steel Co. is being assisted in the introduction of this device by Mr. George L. Moore, former Engineer of Maintenance of the Lehigh Valley Railroad and chairman of the A. R. E. A. Rail Committee.

Semi-Portable Flotation Mill

The Southwestern Engineering Corporation of Los Angeles has reecntly placed on the market a semi-portable flotation mill in two sizes—a 25-ton mill and a 50-ton mill. This mill can be shipped knocked down for easy transportation and assembles on a steel frame which is in three sections. Mill includes a crusher, Feed hopper, belt conveyor, ball mill, classifier, K. K. flotation unit, oil feeder and all shaftings, pulleys, sprockets, chain and belting. The mill when assembled is ready to run with the exception of power, which may already be available or is best determined by mill location. The low cost of the mill and the standard equipment allow of wide use. Bulletins are available from the company.

The new M-S-A miners black wire screen goggle, which serves to reduce eye injuries to a minimum among the men who are working underground, has been announced by the Mine Safety Appliances Co., Pittsburgh, Pa.

Mining Company Adopts Diesel Engines For Power Supply

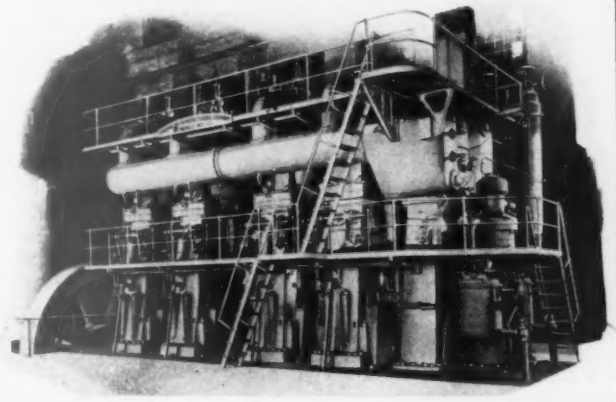
Those who have followed the growth of the Diesel engine in the last few years are fully aware of the tendency toward the use of larger units. This is further evidenced by an order just received by the Nordberg Manufacturing Co. of Milwaukee, Wis., from the Commerce Mining & Royalty Co. of Miami, Okla., for three 2,250-horsepower units, or a total installation of 6,750 horsepower.

This prominent mining company is one of the world's largest producers of lead and zinc. Its operations are confined to the Tri-State field, principally in Ottawa county, in the northeast corner of Oklahoma and in Cherokee county in the southeast corner of Kansas, a section which last year produced more than 50 percent of America's output in lead and zinc. This company has 15 mines and mills in operation, with ore reserves ample for years of continued output. In addition to the mining operations this company also owns the Northeast Oklahoma Railroad, which is electrified.

At present a portion of the power is generated by small and medium sized steam and gas engine units located at widely separated points. The major portion of the power, however, is purchased. With the installation of these three large Diesel units they will comprise the only source of power.

It is planned to locate the Diesel plant at Cardin, Okla., and run transmission lines to the various places where power is used. The longest line will be about 14 miles. This new plant will be laid out with the thought of future expansion to permit of the installation of additional units should power demands later require it. One of the features of the Diesel plant is the ease with which extensions can be made to take care of future growth. Additional units can be added at any time and the high efficiency of the original installation be maintained. Each engine will be connected to a 2,000 K. V. A., 2,300-volt, 3-phase, 25-cycle Westinghouse generator. A large oil storage capacity will be provided to permit the purchase of oil under most favorable conditions.

This new 6,750-horsepower Diesel plant will rank among the largest in North America. It is quite significant that all the installations and all the largest units on this continent consist of Nordberg engines and most of them installed in the mining industry. Among them will be found the 9,400-horsepower plant of the Moctezuma Copper Co. at Nacozari, Sonora, Mexico, and the 6,900-horsepower and 6,250-horsepower installations of the Phelps Dodge Corporation at Bisbee and Morenci, Ariz., respectively. The 2,250-horsepower engines that will be built for the Commerce Mining & Royalty Co. are of the four-cylinder, single acting, two-cycle type. Two engines of this size and type are in the Moctezuma and Phelps Dodge installation, while two more are being installed at Punta Gorda, Fla., by the Florida Power & Light Co. for central station service. These engines and the installations mentioned above will be surpassed in size when the three 3,750-horsepower Nordberg Diesels built for the United States Government for service at the Panama Canal are installed, which will be classed among the world's largest Diesel installations. Two of these 3,750-horsepower engines have now been shipped.



One of three Diesel Engine Units, Each Of 2,250 H. P. Being Constructed For The Commerce Mining & Royalty Co. Of Miami, Okla.

Battery Charging Equipment

As a result of modifications of design, the General Electric Co. is now marketing a complete new line of battery charging equipments in uniform frame sizes. These equipments consist of (1) motor generators, and (2) unit control sections. They are particularly applicable to the multiple charging of batteries used in electric industrial trucks, electric road trucks and storage battery locomotives.

The motor generators are designed to operate at speeds running from 1,800 r. p. m., for the sizes up to 35 kilowatts, to 1,200 r. p. m., on larger sizes. Stocks will be carried of outfits for such special voltages as 32, 45 and 55, together with the standard 115-volt type.

Especial attention has been paid to liberality of design. Commutators and brushes have ample capacity for the high currents required with respect to the Kw. rating.

The generators are flat compounded between no load and three-quarter load, and have slightly drooping characteristics beyond the three-quarter load point. The rise in voltage between these two load points is comparatively small.

A complete new line of unit control sections for these motor generators has been announced. These will be furnished either as part of the complete charging equipment or separately. An important feature of the design is compactness, making it possible to control a large number of circuits in a limited space.

The general line consists of two-circuit sections designed for manual control of the charging rate and the terminating of the charge by means of a contact-making ampere-hour meter located on the truck. Such a section includes, for each circuit, a dial switch for the resistor; a meter-reading switch; an indicating lamp; a double-pole, undercurrent and shunt-trip contactor with two auxiliary circuit contacts; a fuse mounted conveniently on the back of the board, and a resistor, also on the back of the board.

By means of the indicating lamp the operator can tell when the battery is connected to the section. The current is controlled and adjusted by turning the dial switch handle. Amperes and volts are read by the meter-reading switch in connection with a voltmeter and ammeter common to all circuits.

Overcurrent protection is provided by the fuse, and protection against reversal is furnished by the undercurrent contactor. Automatic shut-down at the end of the charge is accomplished by the shunt trip device which is an integral part of the under-current circuit breaker, this circuit being energized from the line and completed through an ampere-hour meter mounted on the electric truck or locomotive.

An important feature of the construction is the ease with which a single section with its two resistors may be removed in a unit if necessary. This is accomplished by removing four cap screws at the corners of the panel and detaching the vertical bus bars from the back of the resistor supports. The entire section may then be easily slid out.

Any number of control sections can be combined with generator sections to make a complete panel. Various modified forms of sections are available and will be furnished for any set of circumstances, thus covering every condition of battery charging.

A New Diesel Engine

A Diesel engine, with many new and distinctive features, has been brought out to meet the specific requirements of the industrial field, according to a statement by the Foos Gas Engine Co., which further states:

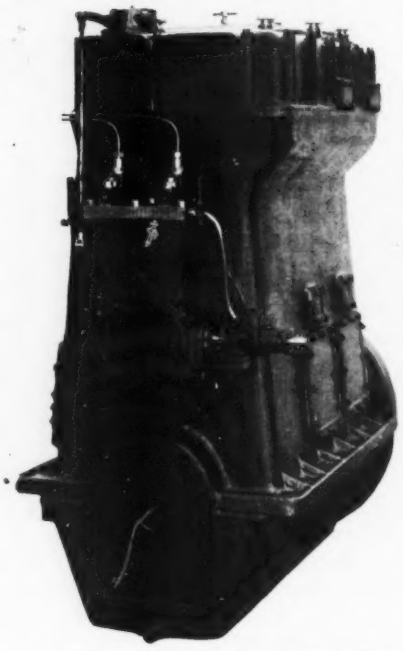
"In application, it is competitive with the gasoline engine that has all but completely replaced the use of steam equipment as self-contained, independnt power plants as well as for driving to the various kinds of industrial machinery. On account of the great economy of the Diesel engine as compared with the gasoline engine, there has been a pronounced call for a Diesel unit of such characteristics as would make possible its installation in industrial uses, such as power shovels and cranes, industrial locomotives, pumps, generators, etc.

"While it would be desirable to have a Diesel engine of approximately the physical proportion and weight of the gasoline units now extensively used, it is not feasible to attempt this duplication. The operating characteristics of a Diesel engine are such as to require more substantial construction, and in comparison with the gasoline engine of the same horsepower rating, more years of service will be secured from the Diesel unit. In order to assure the fabrication of an engine that will have long-lived possibilities it is necessary to allow for bearing surfaces and the cooling volumes considerably in excess of that permitted in a unit of comparatively short-lived service posibilities.

"The Foos Gas Engine Co., of Springfield, Ohio, for years manufacturers of internal combustion engines, are now building the Foos Industrial Diesel. An exterior inspection of this new engine does not identify it as a Diesel engine or perhaps an engine at all since it is entirely enclosed and no moving part is visible. For an engine that is to be the power unit of the general industrial field the complete enclosure feature is one of great value. To operate successfully in such equipment any engine should be completely protected from dust and dirt and foreign matter that might get into the bearings and other working parts. It is obvious that the complete enclosure of the engine saves it from the danger of having tools or other heavy masses falling into the working parts. Complete enclosure has still another advantage in that it confines the lubricating oil that is circulated through the engine. It is impossible for the lubricant to leak from any part of the new unit.

"While completely enclosed, the new engine is yet accessible. Large cover plates are provided on both sides, opposite the crank throws, which give access to the lower part of the main cylinder frame. The top of the engine is provided with cover plates that may be lifted up for inspection of the heads, the valves and the valve mechanism.

"The Foos Industrial Diesel follows in considerable detail the practices that have been followed in the construction of other Foos units. It is a four-cycle engine and operates on the full Diesel combustion cycle. A cross section of the engine indicates a plain Diesel combustion chamber; in other words, the head is perfectly flat, there being no recesses or precombustion chamber, vertically, at the



axis of the cylinder. Complete atomization of the fuel is secured by the mechanical injection principle that has been successfully used in the case of the large stationary Foos Diesel unit.

"It is apparent that the engine designers have given considerable attention to the matter of valves and valve gear. Four valves are provided in each head, two for exhaust and two for inlet. At the level of the head of the main box frame, which houses the entire unit, a recess in the casting provides the air inlet manifold. Accordingly, the air inlet valves are located in the head adjacent to the front side of the engine. Passageway through the main box frame at the back of the engine is provided for the exhaust gases to enter into an exhaust header. For valve operation, a lay-shaft or cam-shaft runs full length of the engine at the level of the cylinder heads. The cam-shaft drive involves the use of a silent chain driven directly from the crank-shaft.

"The whole valve arrangement is very simple and accessible. It is arranged that any of the valves or the valve lever proper may be removed without disturbing any other portion of the mechanism. This simplicity, of course, is absolutely essential since the engine will be called upon to operate in the hands of engineers that may not have experience in the operation of Diesel units.

"Even the flywheel of the new engine is enclosed, operating in a bell housing. All of the fuel pumps and the governor are completely housed, giving them the same protection as is offered the other main working parts of the engine.

"Lubrication of the engine has been taken care of in a very efficient manner. A central lubricating oil system furnishes oil to every bearing in the engine under pressure. In the lower part of the bed plates a trough is provided where the lubricating oil is collected. An oil pump picks up the lubricant, puts it under pressure and distributes it to all the bearings of the engine. Not a single oil cup or grease cup is found on the unit.

"In order to get a Diesel engine down to a low enough weight per horsepower to make it practical for installation on mobile or semi-mobile machinery, a high speed engine is absolutely necessary. The new Foos Industrial Diesel has an operating speed from 400 to 900 r. p. m. Tests that have been made at the factory indicate complete combustion is secured throughout this entire range using low grades of fuel oil. The design of the sprays and the fuel system as a whole is such as permits the use of oils having a low gravity.

"Having such a wide range of speed extends the flexibility of the engine, making its use particularly convenient where direct drive is employed.

"Unquestionably, the new engine will have a very wide field of use since it is to be built in units of several cylinders. Engines of a rating as low as 45 horsepower and as high as 475 horsepower are possible with the one cylinder size and the established range of speed."

Combined Air Compressor and Arc Welder

A combination air compressor and arc welder, driven by a gas engine and mounted on a single base, has been placed on the market by Schramm, Inc., of West Chester, Pa. The outfit consists of a Buda gasoline engine, a Schramm compressor, and a General Electric welding outfit. The complete equipment may be mounted on a standard two-ton truck or can be made portable by adding steel or rubber-tired wheels.

The Buda engine is a 24-horsepower, 800 r. p. m. unit, which may be started and operated independently of either the compressor or welding generator. The Schramm compressor is a two-cylinder, water-cooled machine, with a capacity of 120 cubic feet per minute, and equipped with an automatic unloading device. The air receiver is 16 inches in diameter

by 42 inches high. The General Electric welding equipment consists of a belt-driven WD-12 arc welder with an idler pulley for belt tightening. By the use of a Borg & Beck 12-inch clutch coupling either of the machines may be connected to the engine.

This combination outfit is expected to be of great value in field work. The air compressor can be used to operate drills, grinders and chipping hammers for cutting, peening, caulking and cleaning off scale. The compressor can also be used in preparing work for welding. With the G-E WD-12 welder light and heavy gauge steel can be welded as well as cast iron. After the welding is completed the compressor clutch is thrown and the weld can be ground or chipped as desired. Thus a complete job can be done with the single machine.

The structural steel base is 8 feet 4 inches long, 5 feet 11 inches wide. The outfit is 3 feet 10 inches high. The total net weight of the outfit is 4,000 pounds.

One-Man Control Tandem Storage Battery Locomotive

A recent statement by the Mancha Storage Battery Co., says:

"One of the most recent developments in main haulage locomotives is a one-man control tandem storage battery locomotive designed and built by the Mancha Storage Battery Locomotive Co., of St. Louis, Mo. This unit is built in either flame-proof or open type, and it is particularly adapted to gaseous mines where wires for trolley operated main haulage locomotives are extremely dangerous. The need for a main haulage storage battery locomotive which can be made flame-proof is therefore very apparent.

"One of the obstacles which both the manufacturer and operator has had to avoid in the main haulage locomotives of the storage battery type has been the excessive size and bulk necessary due to the space required for battery large enough to operate a shift on one charge. A locomotive of this type means that its total weight would be approximately 20 tons and its length about 19 feet 6 inches, by a height of close to 50 inches, which would limit its use to the main line where track conditions are maintained at the very best. The tandem unit was built to do main haulage work where conditions would not permit one of the larger main haulage locomotives.

"The first tandem locomotive built by the Mancha Storage Battery Locomotive Co. has been in operation in a southern West Virginia mine for some time and has produced some excellent results.

"This tandem unit is composed of two Mancha Hercules-AX locomotives, each having a battery of 117 lead cells, with a capacity of 62 K. W., which gives a total capacity of 124 K. W. for the unit. This capacity is sufficient to operate the unit one full shift with one charge of the battery.

"The control of the unit is effected by a specially designed connection which permits the operation of both locomotives through one controller on either of the two locomotives, the controller of the opposite locomotive being automatically cut out of the circuit. The controller to be used can be selected at the will of the motorman. This is unique in the operation of storage battery locomotives. Both the brakes and sanding levers are so located in both locomotives to be within easy reach of the motorman regardless of which locomotive he may be riding.

"The electrical connection between the two locomotives is designed with an integral automatic circuit breaker which prevents any arcing or burning of the contacts should the locomotives break apart due to a failure of the draw links between the locomotives. This is an absolute necessity on a locomotive operating in a gaseous mine, however, should the locomotives break apart no harm whatever can be done as the locomotive on which the motorman is riding will continue to run until he shuts off the controller and the other locomotive will have its current cut off instantly at the time of breaking apart. Thus should the draw links fail when hauling a trip, the motorman being on rear locomotive, the leading locomotive would be dead as soon as it reached end of the coupling cable.

"In designing this tandem unit three separate and distinct applications have been kept in mind.

"First, to be used as a main haulage locomotive. Second, the two locomotives to be separated and operated as independent gathering locomotives. Third, each is equipped with a sufficient number of cells to permit each locomotive to be used as a Power Truck supplying the correct voltage for operating cutting machines, loading machines, pumps, etc.

"As a main haulage locomotive, its total weight is approximately 20 tons, but being composed of two separate locomotives, this weight is equally distributed over eight driving wheels, which permits its being operated upon lighter rails and trackage which does not have to be maintained as well as though it were on 20-ton locomotives. Its short overall length; each locomotive being only 13 feet 3 inches, and having a turning length of 10 feet, due to rounded ends, permits its use in places where a large locomotive could not be used. In fact, the unit as a whole is very much more flexible than a large locomotive.

"To operate as individual gathering locomotives, it is only necessary to disconnect and separate them; there are no detachable parts to become lost or mislaid, and when separated each becomes a gathering locomotive having battery capacity of 62 K. W. and weight of about 9½ tons, length 13 feet 3 inches, and a wheel base of 40 inches.

"By the use of an extra battery and box for each locomotive in connection with the Mancha Patented Transfer Rack, the extra battery which has been charged during the day shift can replace the battery on the chassis used during the day shift for haulage and then become a Power Truck for cutting coal on the night shift. As there is provided on each box a receptacle for attaching the trailing cable of a cutting machine, this locomotive not only provides power for operating the cutting machine, but also propels the cutting machine faster than is possible where the cutting machine propels itself.

"It can, therefore, be readily appreciated that a maximum amount of work can be obtained from a flexible unit of this type with a minimum expenditure in initial investment."

Appoints Assistant General Manager

American Rheolaveur Corporation has announced the appointment of Mr. John Griffen, formerly anthracite representative of the Dorr Co., as assistant to the general manager in charge of sales in the anthracite region. Mr. Griffen is a graduate of Lehigh University and has served as assistant fuel engineer for the Lehigh Coal & Navigation Co.; assistant to the president, Harrison Bros. & Co.; fuel engineer, Hudson Coal Co., and manager anthracite territory, the Dorr Co.

Mr. Frank B. Ungar, for many years Chicago representative of the Ludlow Saylor Wire Company, manufacturers of wire cloth and woven wire screens, has been transferred to the general offices of that company in St. Louis and appointed assistant to the general manager of sales.

Mr. Ungar has been connected with the sales department of the Ludlow-Saylor Wire Company for 26 years, and is known to industrial buyers and operating men throughout the country.

The Roberts Tool & Supply Co., of Syracuse, N. Y., has recently been appointed district representatives for the line of IXL Speed Reducers and Gear Products manufactured by the Foote Bros. Gear & Machine Co. They will operate in Syracuse and vicinity.

George R. Sanders is in charge of the Joplin office of the Southwestern Engineering Corporation of Los Angeles as District Manager, with Charles E. Wood as Assistant Engineer.

Dorr Takes Over Fahrenwald Sizer

The Dorr Co., Engineers, 247 Park Avenue, has recently announced that it has taken over the manufacturing and selling of the Fahrenwald Sizer, a hydraulically operated machine that was developed after a long series of tests by A. W. Fahrenwald of the United States Bureau of Mines.

The Sizer is something entirely new in the field of hindered settling classification, and numerous installations of the machine for preparing feed for concentrating tables have resulted in remarkable improvements in table operation.

The applications of the Sizer may be briefly summed up as follows:

It will take an unsized feed in which the particles are of uniform specific gravity and deliver a number of closely sized products. It will take an unsized feed in which the particles are not of uniform specific gravity and will deliver a series of hydraulically classified products. It will take a sized feed in which the particles are not of uniform specific gravity and separate the particles according to specific gravities, or in other words, make a concentration. The Sizer is a six-pocket machine, the compartments having straight, nonsloping sides, so that the velocity of the hydraulic water is uniform over the whole area. The spigot discharge valve is controlled by a diaphragm, sensitive to every change of conditions in the classifying pockets, and this automatically insures uniform quality of the spigot products. Very little hydraulic water is required, and once adjusted the Sizer is automatic in operation and will even start up after a shut down without supervision. It is a light compact machine, taking little floor space, is easily handled and simple to install. These features should assure for this machine a cordial reception wherever problems of sizing, sorting, concentration or separation arise.

Successor to G. M. Johnson Co.

Announcement has just been received of the complete reorganization of the G. M. Johnson Co., of Jeannette, Pa. The new company will be known as the Fort Pitt Mine Equipment Co., with entirely new personnel, manufacturing and sales policies. The officers of the Fort Pitt Mine Equipment Co. are: Frank J. Lanahan, president; E. W. Wright, vice president; P. J. Meehan, secretary and treasurer; M. E. Nolan, general sales manager; and Louis E. Endsley, consulting engineer. The company manufactures automatic gravity feeders, all steel safety mine cages, safety horn car stops, chain rail car conveyors, automatic stopping, locking and releasing systems for mine cages.

G. E.'s Sales

The General Electric Co.'s net sales billed for the first six months of the current year, ended June 30, 1926, totaled $147,450,867.96, and the profit available for dividends on the common stock and surplus is $19,000,392.63.

This announcement, which indicates net earnings equivalent to about $2.63 per share on the 7,211,481 shares of new no par value stock, was made by President Gerard Swope in accordance with a new plan of the company for reporting earnings quarterly to the stockholders, in addition to the statement of orders received which has heretofore been sent stockholders every three months.

General Electric Suggestion System

Awards totalling $22,602 were paid to 2,172 employes of the General Electric Company during the first six months of the current year for suggestions which ranged from safety devices for the protection of workers to improved methods of manufacturing.

In all 7,080 suggestions were made, an increase of approximately 1,500 over the first six months of last year, showing a gradual increase in the interest by employes in the company's suggestion system. For the first half of 1925 awards were made totaling $17,510, to 1,693 employes.

The awards, which ranged up to $500, were paid at the option of the recipient either in cash or G-E Employes Securities Corporation bonds, which yield 8 percent as long as the original holder remains in the employ of the company.

Change In Trade Name

The Goulds Manufacturing Co., organized in 1869, to build a wide variety of products, in accordance with the elimination of these items and their concentration upon one product—Goulds Pumps—has changed their trade name to Goulds Pumps, Inc. There is no change in organization, business policy or ownership. The board of directors, officers, managers and personnel remain the same.

Removal of Office

Hyatt Roller Bearing Co., Newark, N. J., has announced the removal of its Mine Car Division to Pittsburgh, Pa., where their offices will be located in Room 1352, Union Trust Building.

The Indianapolis Belting & Supply Co., 34 S. Capital St., Indianapolis, Ind., has recently been appointed as district representatives for the IXL Speed Reducers and Gear Products, manufactured by the Foote Bros. Gear & Machine Co.

New Contracts Allotted

American Rheolaveur Corporation announces new contracts for installation of Rheolaveur plants in the colleries of the following companies: Pardee Bros. & Co., Glen Alden Coal Co., Lehigh Valley Coal Co., American Smelting & Refining Co., Pacific Coast Coal Co., Teton Coal Co., Shamokin Coal Co., Kingston Coal Co., and Philadelphia & Reading Coal & Iron Co. These plants range in capacities from a 240-ton-per-day plant, handling silt up to a 3,000-ton-per-day plant handling mixed sizes 3½ inches and finer.

Austin Gets Contract

A $6,000,000 automobile plant, one of the largest industrial building contracts in the country let this year, has been placed with the Austin Co., Cleveland. The new Pontiac plant for Oakland Motor Car Co. is to be built at Pontiac, Mich.

Work was started July 23. This construction contract followed close on the heels of an engineering contract which was placed with Austin in June.

Blasters' Information

Atlas Powder Co., Wilmington, Del., has issued two pamphlets on Blasting, referred to as Atlas Special Blaster No. 2 and No. 00, which contain valuable information concerning a 10-shot key operated machine that can be carried conveniently in the blaster's pocket and a single shot key operated blaster that is the smallest and most compact blaster on the market.

Air Lift Pumping Methods

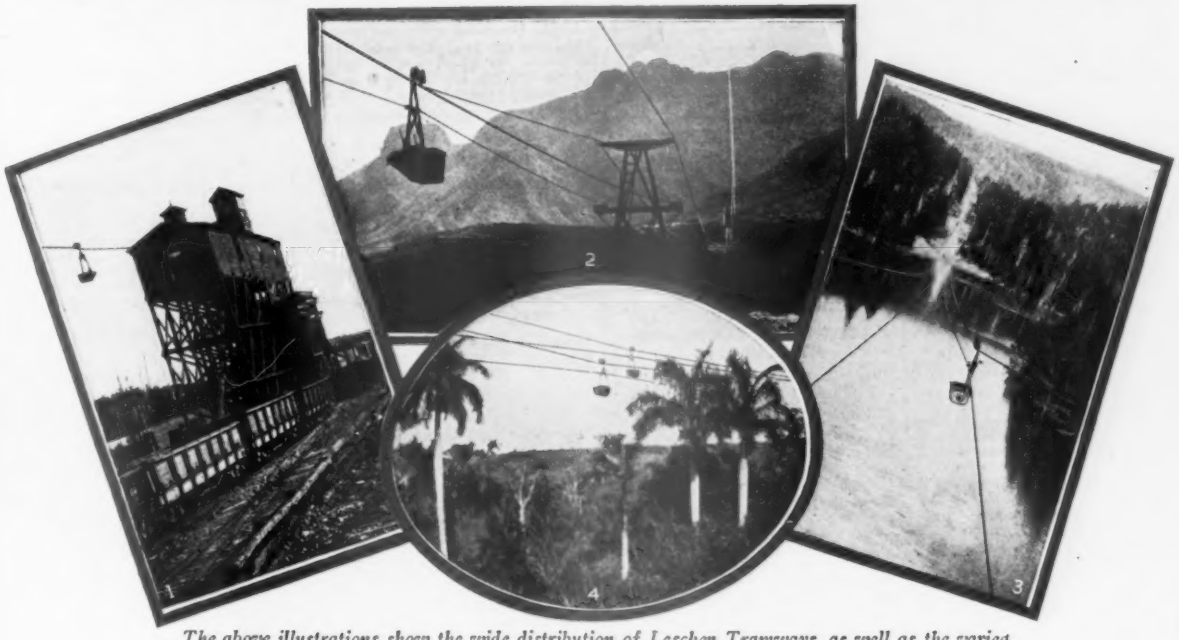
Bulletin No. 71-I carries 48 pages on Sullivan Air Lift Pumping Methods and Equipment. Copies may be obtained upon request to Sullivan Machinery Co., Chicago, Ill.

West Virginia Rail Company has issued a circular concerning a new tie. It is particularly designed for use in main line work of 40 to 60 pound rails Copy will be mailed upon request to their Huntington, W. Va., office.

General Electric Review in its August issue carries an interesting article by Wayman A. Holland on Control and Protection of Three-Wire Direct-Current Generators.

Handy Hoisting and Hauling, Boooklet No. 123, has been published by the Sullivan Machinery Co. The purpose of this booklet is to show the wide variety of application of small portable hoists. It shows between 60 and 70 different applications.

"LESCHEN"



The above illustrations show the wide distribution of Leschen Tramways, as well as the varied conditions under which they are working: No. 1—General Chemical Co., in Ontario, Canada. No. 2—Teziutlan Copper Company, in Mexico. No. 3—Anaconda Copper Mining Co., in California. No. 4—American Metal Co., in Cuba.

AERIAL TRAMWAYS: The extensive adoption by the mining industry of the Leschen Systems of Aerial Tramways is recognition of their suitability, sturdy construction and economical performance. While they are often used under conditions where no other method of transportation is practicable, they are also installed in direct competition with other methods, as they are cheaper in the long run.

Our engineers will gladly give you any desired information on the advantages of aerial transportation. If you have a transportation problem, you will find our Catalog No. T-25 very interesting.

WIRE ROPE: Leschen Wire Rope has a long and well-known record for economical service in the mining industry. For use on heavy-duty hoists, inclines, dredges and steam shovels, we recommend HERCULES [**Red Strand**] Wire Rope. Its extra strength, elasticity, toughness, and durability make it an important factor in reducing operating costs.

Manufactured By **A. Leschen & Sons Rope Co.** *Established 1857*

5909 Kennerly Ave., St. Louis

New York **Chicago** **Denver** **San Francisco**

"HERCULES" (RED STRAND) WIRE ROPE

Reg. U. S. Pat. Off.

BUYER'S DIRECTORY

ACETYLENE, Dissolved (Or in Cylinders)
Prest-O-Lite Co., Inc., 30 E. 42nd St., N. Y. C.

ACETYLENE GAS
Prest-O-Lite Co., 30 East 42nd St., New York City.

ACETYLENE GENERATING APPARATUS
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

ACID, SULPHURIC
Irvington Smelting & Refining Works, Irvington, N. J.

AERIAL TRAMWAYS
American Steel & Wire Co., Chicago and New York.

AIR COMPRESSORS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City.

AUTOMATIC CAR CAGES
Car-Dumper & Equipment Co., Grand Crossing, Chicago, Ill.
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

AUTOMATIC (Mine Doors, Truck and Electric Switches)
American Mine Door Co., Canton, Ohio.

AUTOMATIC SWITCH THROWERS
American Mine Door Co., Canton, Ohio.

BATTERIES (Storage, Gas Welding, Cutting, Dissolved Acetylene)
Prest-O-Lite Co., 30 East 42nd St., New York City.

BEARINGS (Roller)
Hyatt Roller Bearing Co., Harrison, N. J.

BELTING (Conveyor, Elevator, Transmission)
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

BELTING, SILENT CHAIN
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

BINS (Coke and Coal)
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

BIT SHARPENERS
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City.

BLACK DIAMONDS
R. S. Patrick, Sellwood Building, Duluth, Minn.

BLASTING POWDER
Atlas Powder Co., Wilmington, Del.
E. I. du Pont de Nemours & Co., Inc., Wilmington, Delaware.
Hercules Powder Co., 934 King St., Wilmington, Del.

BLASTING SUPPLIES
Atlas Powder Co., Wilmington, Del.
E. I. du Pont de Nemours & Co., Inc., Wilmington, Delaware.
Hercules Powder Co., 934 King St., Wilmington, Del.

BLOWERS, CENTRIFUGAL
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

BLOWPIPES, Brazing, Carbon Burning, Cutting, Lead Burning, Welding, Welding and Cutting
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

BOND TERMINALS
Amer. Mine Door Co., Canton, Ohio.

BREAKER MACHINERY
Vulcan Iron Works, Wilkes-Barre, Pa.

BREAKERS (Construction and Machinery)
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

BRIQUETTING MACHINERY
Vulcan Iron Works, Wilkes-Barre, Pa.

BUCKETS (Elevator)
Hendrick Mfg. Co., Carbondale, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CABLES
American Steel & Wire Co., Chicago and New York.

CABLES (Connectors and Guides)
American Mine Door Co., Canton, Ohio.
Leschen & Sons Rope Co., A., St. Louis, Mo.

CABLEWAYS
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

CAGE (Safety Appliances)
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

CAGERS, AUTOMATIC
Car-Dumper & Equipment Co., Grand Crossing, Chicago, Ill.
Mining Safety Device Co., Bowerston, Ohio.

CAGES
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Car-Dumper & Equipment Co., Grand Crossing, Chicago, Ill.
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Vulcan Iron Works, Wilkes-Barre, Pa.

CAGES (Self-dumping)
Car-Dumper & Equipment Co., Grand Crossing, Chicago, Ill.

CAGE STOPS AND LOCKS
Mining Safety Device Co., Bowerston, Ohio.

CALCINERS
Vulcan Iron Works, Wilkes-Barre, Pa.

CARBON AND BORTZ
R. S. Patrick, Sellwood Building, Duluth, Minn.

CARBON BURNING APPARATUS
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

CARBON RODS AND PASTE FOR WELDING
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

CAR DUMPERS (Rotary)
Car-Dumper & Equipment Co., Grand Crossing, Chicago, Ill.

CAR HAULS
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, O.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CAR STOPS (Automatic)
Car-Dumper & Equipment Co., Grand Crossing, Chicago, Ill.

CAR WHEEL BEARINGS
Hyatt Roller Bearing Co., Harrison, N. J.

CASTINGS
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CASTINGS, GRAY IRON
Vulcan Iron Works, Wilkes-Barre, Pa.

CASTINGS, OPEN HEARTH STEEL
Vulcan Iron Works, Wilkes-Barre, Pa.

CHAINS
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, AUTOMOBILE ENGINE
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, COAL CUTTING
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CHAINS, DRIVE
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, FRONT END
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, OILING
Morse Chain Co., Ithaca, N. Y.

CHAINS, POWER TRANSMISSION
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, SILENT (Rocker-Joint)
Morse Chain Co., Ithaca, N. Y.

CHAINS, SLING
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, SPROCKET WHEEL
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CLAMPS, HOSE
Knox Mfg. Co., Philadelphia, Pa.

CLAMPS (Trolley)
Ohio Brass Co., Mansfield, Ohio.

CLUTCHES
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

COAL CLEANING MACHINERY
Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.

COAL COMPANIES
General Coal Company, Land Title Bldg., Philadelphia, Pa.
Lehigh Coal & Navigation Co., Philadelphia, Pa.
Thorne, Neale & Co., Philadelphia, Pa.

COAL CRUSHERS
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

COAL CRUSHERS & ROLLS
Vulcan Iron Works, Wilkes-Barre, Pa.

COAL CUTTERS
Goodman Mfg. Co., Halsted St. and 48th Pl. Chicago Ill.
Howells Mining Drill Co., Plymouth, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

COAL HANDLING MACHINERY
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

COAL LOADERS
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

COAL MINING MACHINERY
Goodman Mfg Co., Halsted St. and 48th Pl Chicago. Ill.
Howells Mining Drill Co., Plymouth, Pa.
Ingersoll Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

COAL MINING PLANTS
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.

COMPRESSORS, AIR
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co., 11 Broadway, New York City.

COMPRESSORS, MINE CAR
Ingersoll-Rand Co., 11 Broadway, New York City.

CONCENTRATORS (Table)
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

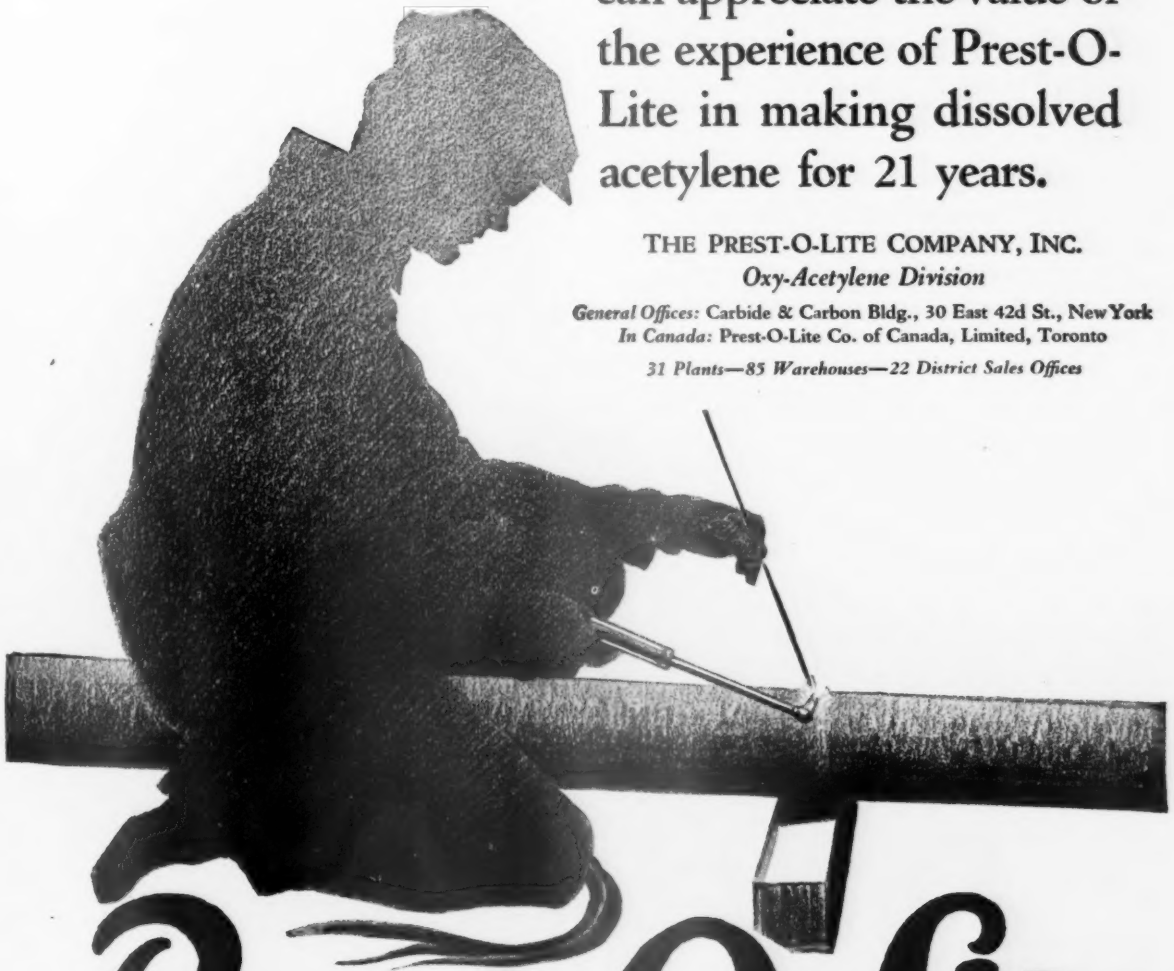
CONCRETE REINFORCEMENT
American Steel & Wire Co., Chicago and New York

CONDENSERS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll Rand Co., 11 Broadway, New York City.

CONTROLLERS
Goodman Mfg Co., Halsted St. and 48th Place, Chicago, Ill.

Experience

You who have had years of experience in manufacturing realize how experience is reflected in the product. Therefore you can appreciate the value of the experience of Prest-O-Lite in making dissolved acetylene for 21 years.



THE PREST-O-LITE COMPANY, INC.
Oxy-Acetylene Division

General Offices: Carbide & Carbon Bldg., 30 East 42d St., New York
In Canada: Prest-O-Lite Co. of Canada, Limited, Toronto

31 Plants—85 Warehouses—22 District Sales Offices

Prest-O-Lite
DISSOLVED ACETYLENE

CONVERTORS, COPPER
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

CONVEYOR BEARINGS
Hyatt Roller Bearing Co., Harrison, N. J.

CONVEYORS
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CONVEYORS, BELT
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CONVEYORS, CHAIN FLIGHT
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CONVEYORS, COAL
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CONVEYORS AND ELEVATORS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CONVEYORS, PAN OR APRON
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CONVEYORS, SCREW
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

COOLERS, ROTARY
Vulcan Iron Works, Wilkes-Barre, Pa.

CORE DRILLING
H. R. Ameling Prospecting Co., Rolla, Mo.
Hoffman Bros., Punxsutawney, Pa.

COUPLINGS, FLEXIBLE
Fawcus Machine Co., Pittsburgh, Pa.

COUPLINGS, ROCK DRILL
Knox Mfg. Co., Philadelphia, Pa.

CROSSINGS AND CROSSOVERS
Central Frog & Switch Co., Cincinnati, Ohio.

CRUSHERS
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

CRUSHERS, COAL
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CRUSHERS, SINGLE & DOUBLE ROLL
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CRUSHING PLANTS, COKE
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CUTTING APPARATUS, Oxy-Acetylene, Oxy-Hydrogen
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

DECARBONIZING APPARATUS
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

DESIGNERS OF PLANTS
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

DIAMOND CORE DRILL CONTRACTING
H. R. Ameling Prospecting Co., Rolla, Mo.
Hoffman Bros., Punxsutawney, Pa.

DIAMOND DRILLING CARBON
R. S. Patrick, Sellwood Building, Duluth, Minn.

DIAMONDS, BLACK (See Carbon and Bortz)
R. S. Patrick, Sellwood Building, Duluth, Minn.

DOORS, AUTOMATIC MINE
American Mine Door Co., Canton, Ohio.

DOUBLE CRIMPED WIRE SCREENS
Ludlow-Saylor Wire Co., 608 S. Newstead Ave., St. Louis, Mo.

DRIFTERS, DRILL
Ingersoll-Rand Co., 11 Broadway, New York City.

DRILLING, DIAMONDS FOR
R. S. Patrick, Sellwood Building, Duluth, Minn.

DRILLS, AIR AND STEAM
Howells Mining Drill Co., Plymouth, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.

DRILLS (Blast Hole)
Howells Mining Drill Co., Plymouth, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.

DRILLS, CORE
H. R. Ameling Prospecting Co., Rolla, Mo.
Hoffman Bros., Punxsutawney, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.
Keystone Churn Drill Co., Beaver Falls, Pa.

DRILLS, ELECTRIC
General Electric Co., Schenectady, N. Y.
Howells Mining Drill Co., Plymouth, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

DRILLS, HAMMER
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

DRILLS (Hand Operated Coal)
Howells Mining Drill Co., Plymouth, Pa.
Ohio Brass Co., Mansfield, Ohio.

DRILLS, PNEUMATIC
Howells Mining Drill Co., Plymouth, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.

DRILLS, PROSPECTING
H. R. Ameling Prospecting Co., Rolla, Mo.
Hoffman Bros., Punxsutawney Pa.
Howells Mining Drill Co., Plymouth, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.
Keystone Churn Drill Co., Beaver Falls, Pa.

DRILLS, ROCK
Diamond Machine Co., Monongahela, Pa.
General Electric Co., Schenectady, N. Y.
Howells Mining Drill Co., Plymouth, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

DRILL STEEL SHARPENERS
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

DRIVES, SILENT CHAIN
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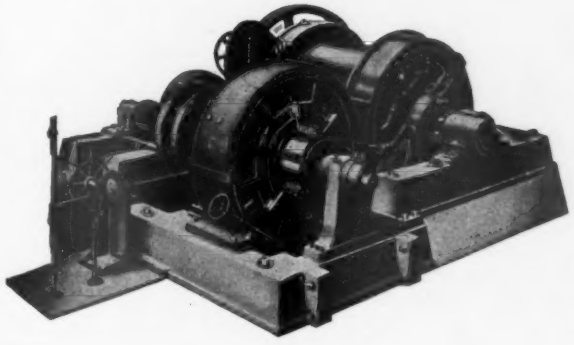

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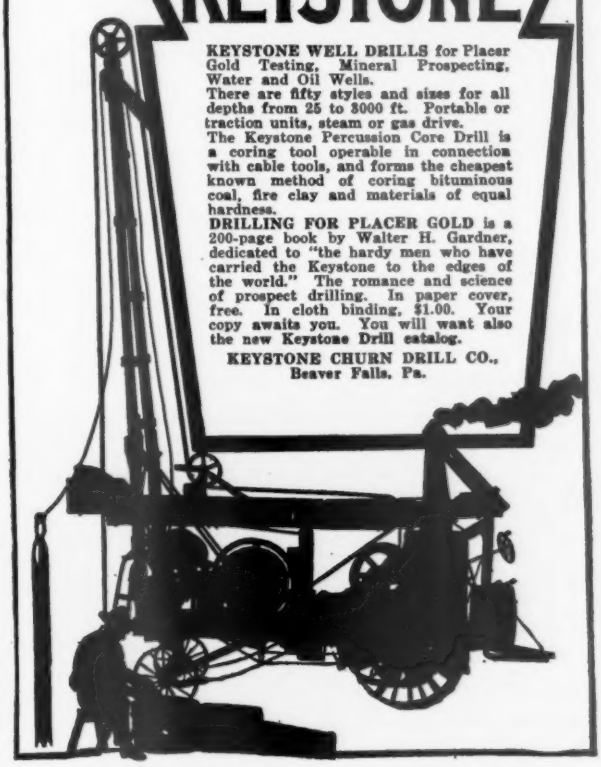

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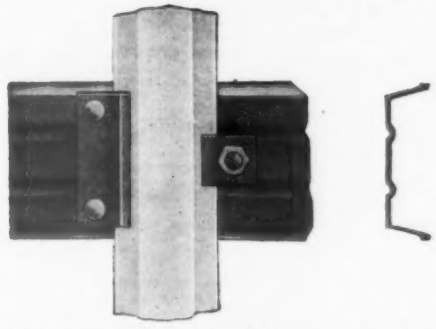

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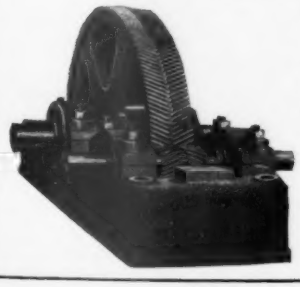

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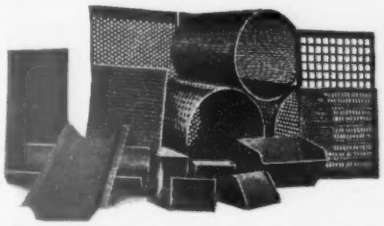

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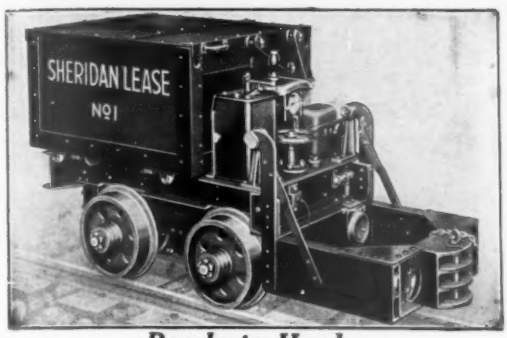

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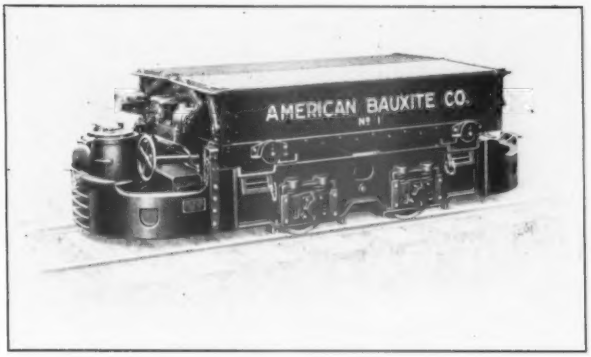

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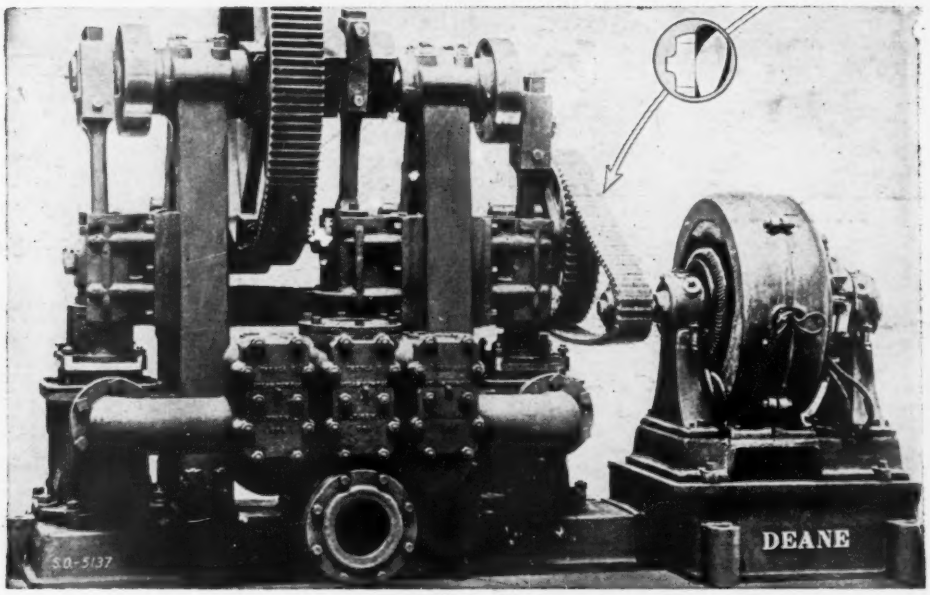

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